

**MONOLITHIC 1.5-CHANNEL H BRIDGE DRIVER CIRCUIT FOR CAMERAS****DESCRIPTION**

The  $\mu$ PD16886 is a monolithic H bridge driver LSI that employs N-channel MOSFETs in its output stage.

This IC incorporates a 1.5-channel H bridge circuit and can control two motors that do not operate at the same time. In addition, forward/reverse, brake, and stop functions are available, making this LSI ideal for driving motors such as the motor for winding the camera film and the lens zoom motor.

**FEATURES**

- Large output current     $I_{D(DC)} = 1.0 \text{ A}$     During continuous operation  
     $I_{D(pulse)} = 2.8 \text{ A}$      $PW \leq 20 \text{ ms}$ , during single operation  
     $I_{D(pulse)} = 2.2 \text{ A}$      $PW \leq 200 \text{ ms}$ , during single operation
- On-chip 1.5-channel H bridge circuit
- Low on-resistance     $R_{ON} = 0.5 \Omega \text{ max.}$     Sum of the top and bottom on-resistance, total temperature range
- On-chip standby circuit to set the charge pump circuit to OFF
- Low-voltage operation is possible (operable at 2.7 V or higher)
- On-chip undervoltage lockout circuit
- Mounted in a small-scale package    24-pin plastic TSSOP

**ORDERING INFORMATION**

Part Number	Package
$\mu$ PD16886MA-6A5	24-pin plastic TSSOP (5.72 mm (225))

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**ABSOLUTE MAXIMUM RATINGS**

(T<sub>A</sub> = 25°C: MOUNTED ON GLASS EPOXY BOARD 100 mm × 100 mm × 1 mm, COPPER FILM AREA: 15%)

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage	V <sub>DD</sub>		-0.5 to +6.0	V
	V <sub>M</sub>	When charge pump operating	-0.5 to +4.0	V
		At V <sub>G</sub> external input	-0.5 to +6.0	
V <sub>G</sub> pin apply voltage	V <sub>G</sub>	At V <sub>G</sub> external input	8.0	V
Input voltage	V <sub>IN</sub>		-0.5 to V <sub>DD</sub> + 0.5	V
Output current (DC)	I <sub>D(DC)</sub>	During successive operation	±1.0	A
Output current (pulse)	I <sub>D(pulse)</sub>	PW < 20 ms, single pulse	±2.8	A
Output current (pulse)	I <sub>D(pulse)</sub>	PW < 200 ms, single pulse	±2.2	A
Power consumption	P <sub>T</sub>		0.7	W
Peak junction temperature	T <sub>J(MAX)</sub>		150	°C
Storage temperature	T <sub>stg</sub>		-55 to +150	°C

**RECOMMENDED OPERATING CONDITIONS**

(T<sub>A</sub> = 25°C: MOUNTED ON GLASS EPOXY BOARD 100 mm × 100 mm × 1 mm, COPPER FILM AREA: 15%)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Supply voltage	V <sub>DD</sub>		2.7		5.5	V
	V <sub>M</sub>		1.6		3.6	V
V <sub>G</sub> pin apply voltage	V <sub>G</sub>		V <sub>M</sub> + 3.5		7.5	V
Output current (DC)	I <sub>D(DC)</sub>	During successive operation			0.8	A
Output current (pulse)	I <sub>D(pulse)</sub>	PW < 20 ms, single pulse			2.5	A
Output current (pulse)	I <sub>D(pulse)</sub>	PW < 200 ms, single pulse			2.0	A
Charge pump capacitor capacitance	C <sub>1</sub> to C <sub>3</sub>			0.01		μF
Operating ambient temperature	T <sub>A</sub>		-20		+75	°C
Peak junction temperature	T <sub>J(MAX)</sub>				125	°C

**ELECTRICAL SPECIFICATIONS (UNLESS OTHERWISE SPECIFIED, T<sub>A</sub> = 25°C, V<sub>DD</sub> = V<sub>M</sub> = 3.0 V)**

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
V <sub>DD</sub> pin current	I <sub>DD</sub>	STB = V <sub>DD</sub>			2.0	mA
	I <sub>DD(STB)</sub>	STB = GND			1.0	μA
V <sub>M</sub> pin current in off state	I <sub>MOFF</sub>	Control pin at low level			1.0	μA
Input voltage, high	V <sub>IH</sub>		1.8		V <sub>DD</sub>	V
Input voltage, low	V <sub>IL</sub>				0.8	V
Input pull-down resistor	R <sub>IND</sub>			200		kΩ
Output on-resistance	R <sub>ON</sub>	-20°C ≤ T <sub>A</sub> ≤ 75°C I <sub>D</sub> = 0.8 A C <sub>1</sub> = C <sub>2</sub> = C <sub>3</sub> = 0.01 μF		0.35	0.5	Ω
Low voltage detection voltage	V <sub>DDS</sub>		0.8		2.5	V
Charge pump circuit turn-on time	t <sub>ONC</sub>	C <sub>1</sub> = C <sub>2</sub> = C <sub>3</sub> = 0.01 μF			1.0	ms
H bridge circuit turn-on time	t <sub>ON</sub>	I <sub>D</sub> = 0.8 A, see <b>Figures 1 and 2</b>			5.0	μs
H bridge circuit turn-off time	t <sub>OFF</sub>				5.0	μs

The output is high impedance during low-voltage detection.

The V<sub>G</sub> pin voltage when using the charge pump is V<sub>G</sub> ≈ V<sub>M</sub> + 3.6 V.

Figure 1. Charge Pump Characteristics Waveform

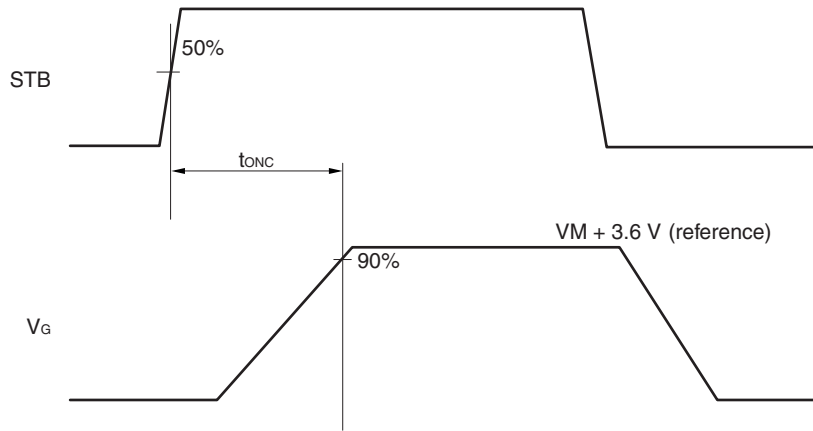
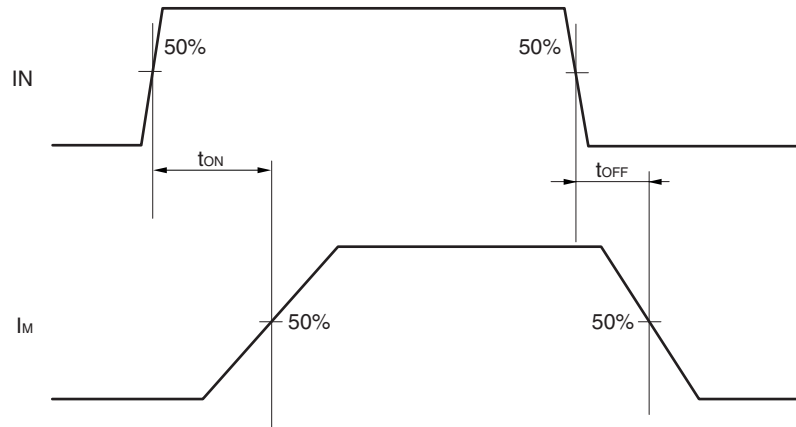
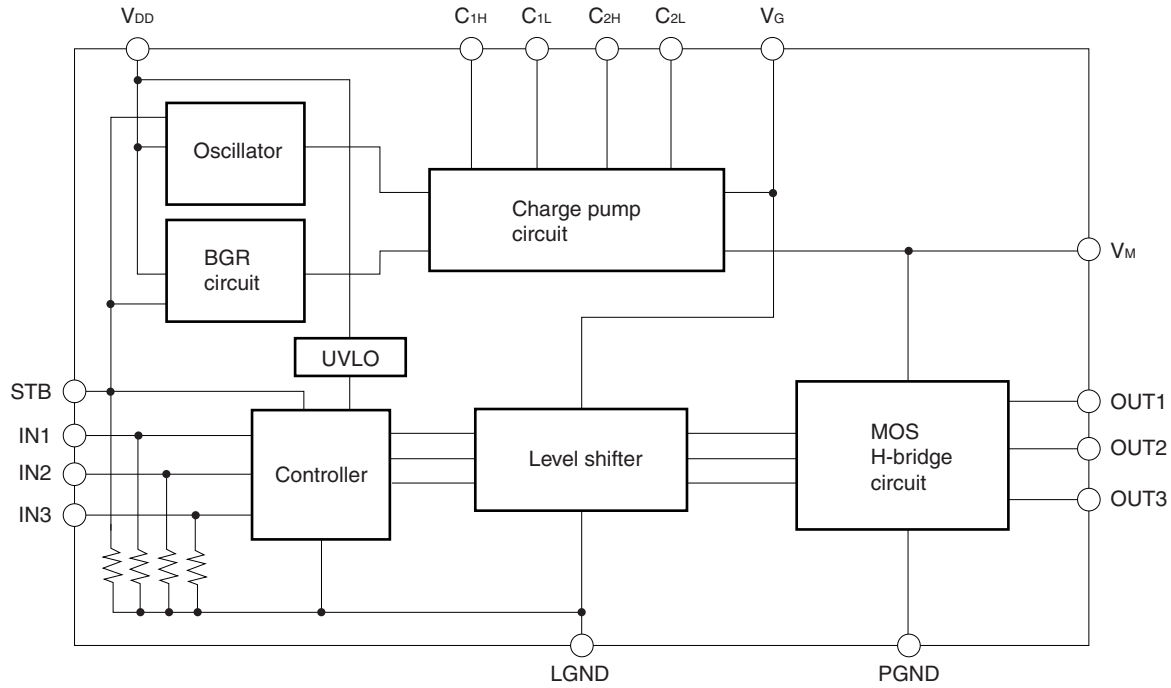


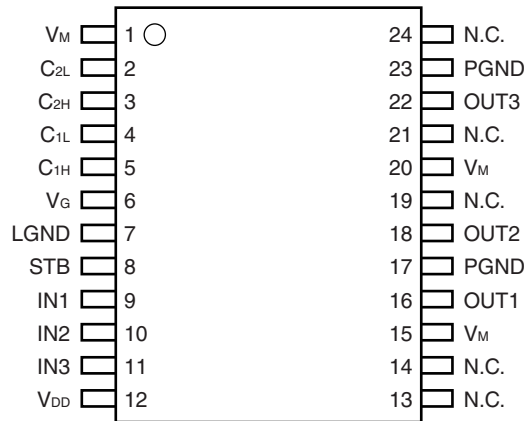
Figure 2. Switching Characteristics Waveform



**BLOCK DIAGRAM**

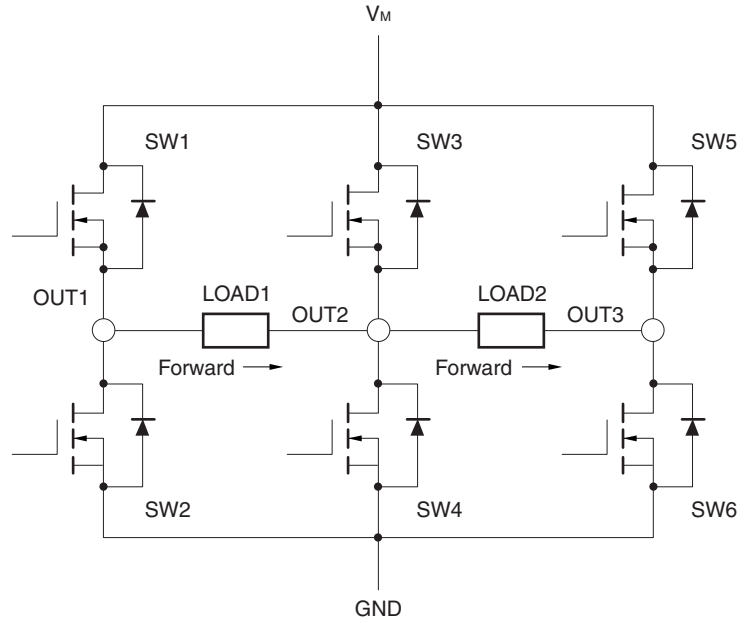


**PIN CONFIGURATION**



Pin No.	Pin Name	Pin Function	Pin No.	Pin Name	Pin Function
1	V <sub>M</sub>	Motor block supply voltage pin	13	N.C.	Unused pin
2	C <sub>2L</sub>	Charge pump capacitor connection pin	14	N.C.	Unused pin
3	C <sub>2H</sub>	Charge pump capacitor connection pin	15	V <sub>M</sub>	Motor block supply voltage pin
4	C <sub>1L</sub>	Charge pump capacitor connection pin	16	OUT1	H bridge output pin
5	C <sub>1H</sub>	Charge pump capacitor connection pin	17	PGND	Output block GND pin
6	V <sub>G</sub>	Gate voltage input pin	18	OUT2	H bridge output pin
7	LGND	Control block GND pin	19	N.C.	Unused pin
8	STB	Standby pin	20	V <sub>M</sub>	Motor block supply voltage pin
9	IN1	Input pin	21	N.C.	Unused pin
10	IN2	Input pin	22	OUT3	H bridge output pin
11	IN3	Input pin	23	PGND	Output block GND pin
12	V <sub>DD</sub>	Control block supply voltage pin	24	N.C.	Unused pin

**FUNCTION TABLE (OUTPUT BLOCK CONNECTION)**

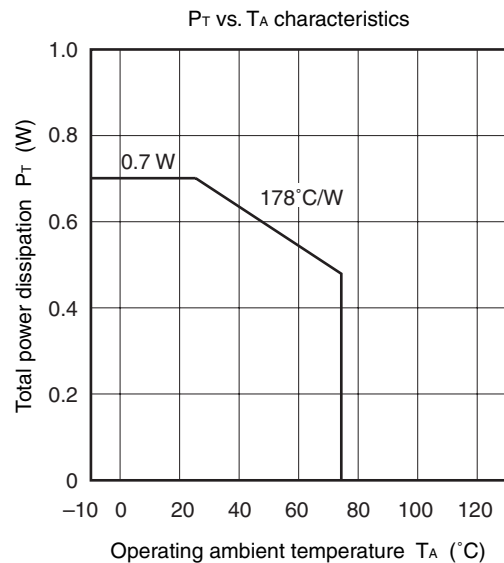


**(Truth Table)**

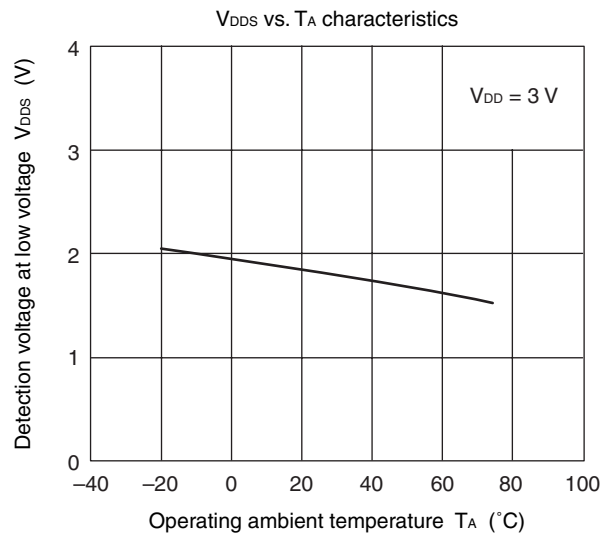
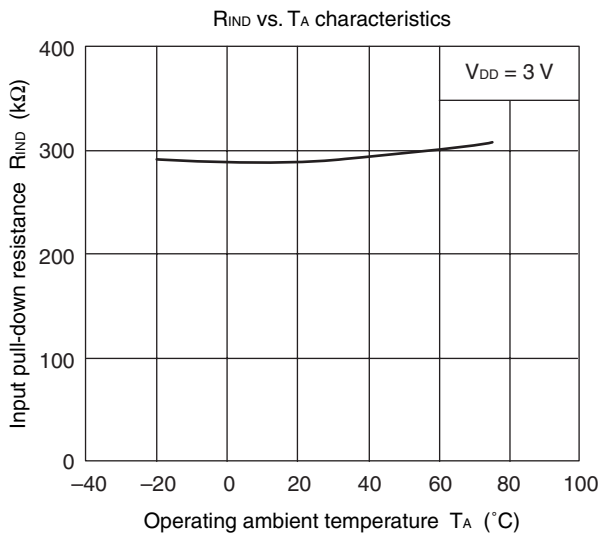
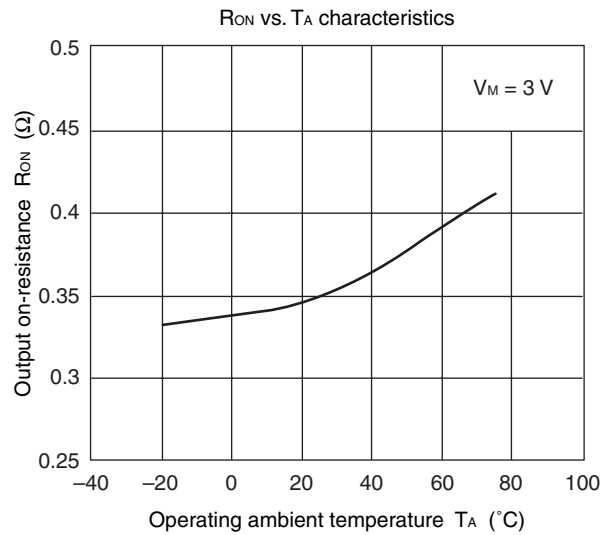
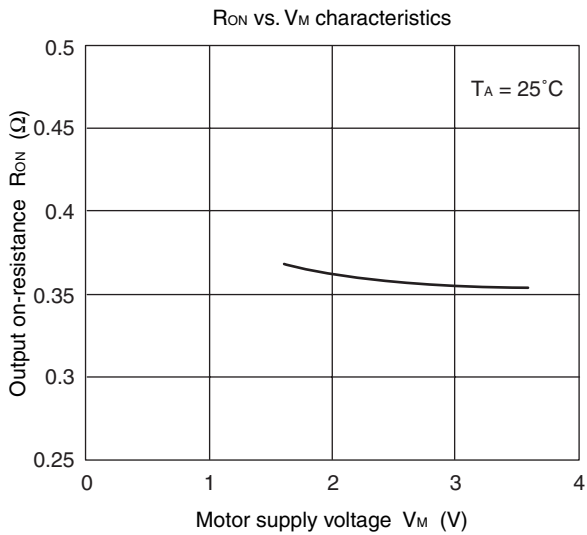
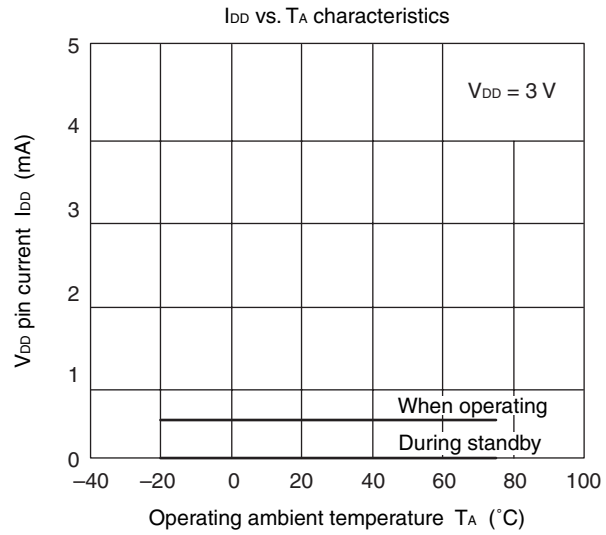
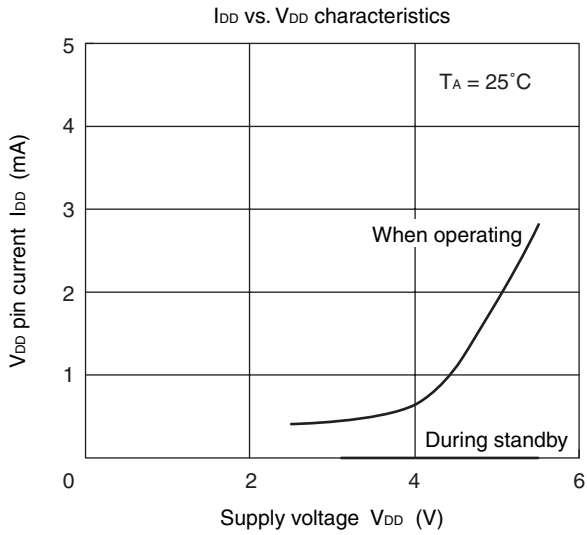
Input Signal				Circuit Operation	Current Route
IN1	IN2	IN3	STB		
L	H	L	H	1 ch forward	$V_M \rightarrow \text{OUT1} \rightarrow \text{LOAD1} \rightarrow \text{OUT2} \rightarrow \text{GND}$
L	L	H	H	1 ch reverse	$V_M \rightarrow \text{OUT2} \rightarrow \text{LOAD1} \rightarrow \text{OUT1} \rightarrow \text{GND}$
L	H	H	H	1 ch brake	Only SW2 and SW4 are on
H	H	L	H	2 ch forward	$V_M \rightarrow \text{OUT2} \rightarrow \text{LOAD2} \rightarrow \text{OUT3} \rightarrow \text{GND}$
H	L	H	H	2 ch reverse	$V_M \rightarrow \text{OUT3} \rightarrow \text{LOAD2} \rightarrow \text{OUT2} \rightarrow \text{GND}$
H	H	H	H	2 ch brake	Only SW4 and SW6 are on
-	L	L	H	Stopped	SW1 to SW6 are all off
-	-	-	L	Standby	Charge pump circuit stopped

Unused switches (example: SW1 and SW2 at 2 ch driving) are high impedance.

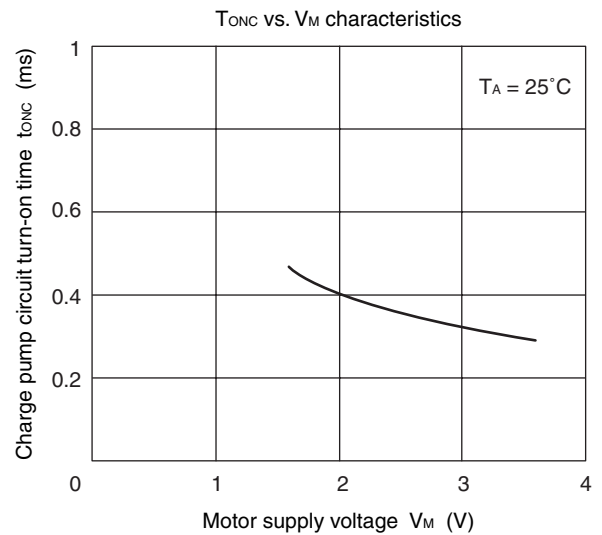
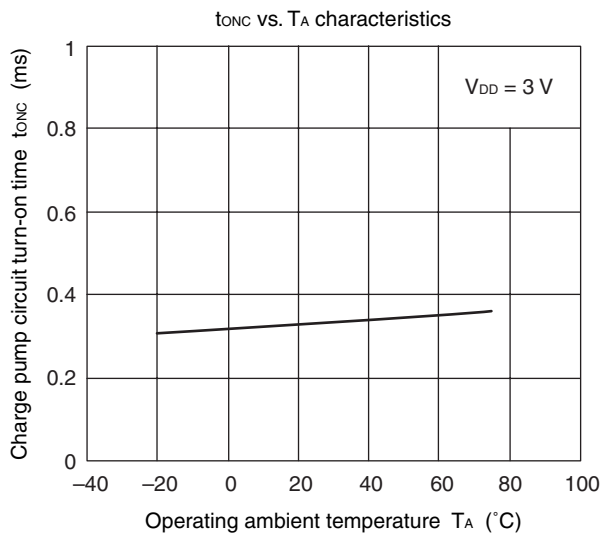
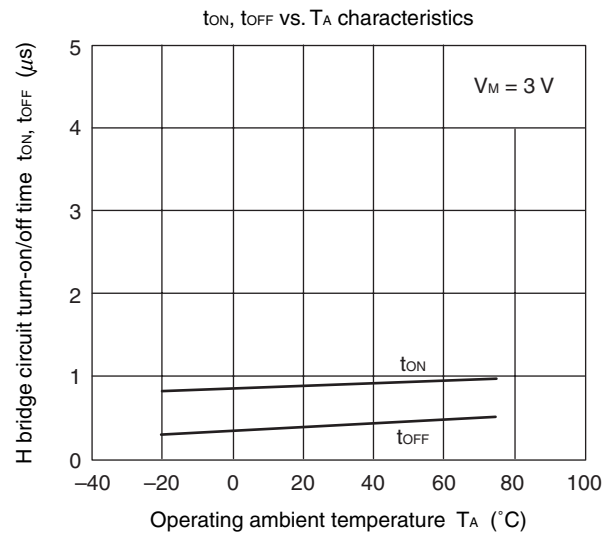
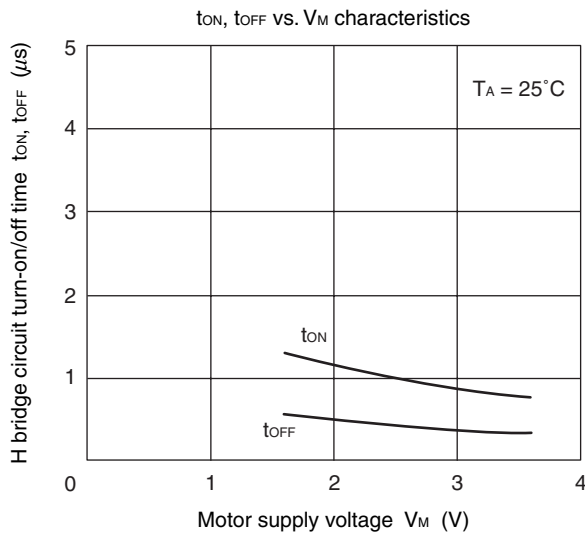
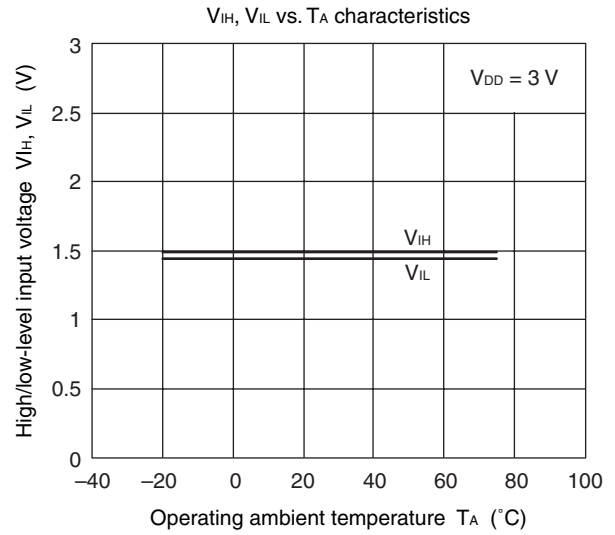
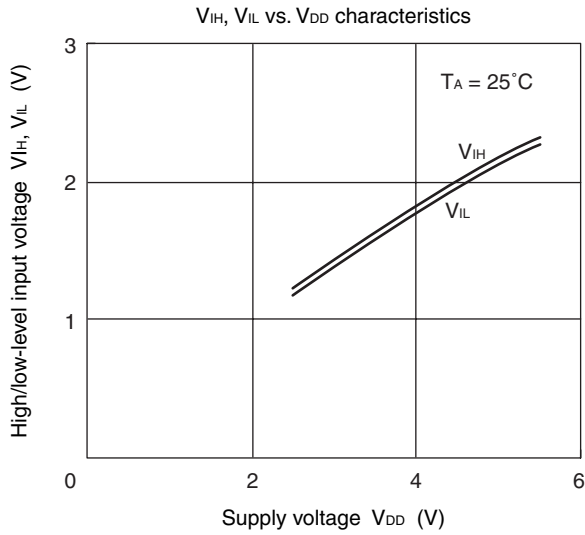
**CHARACTERISTICS CURVES**



CHARACTERISTICS CURVES

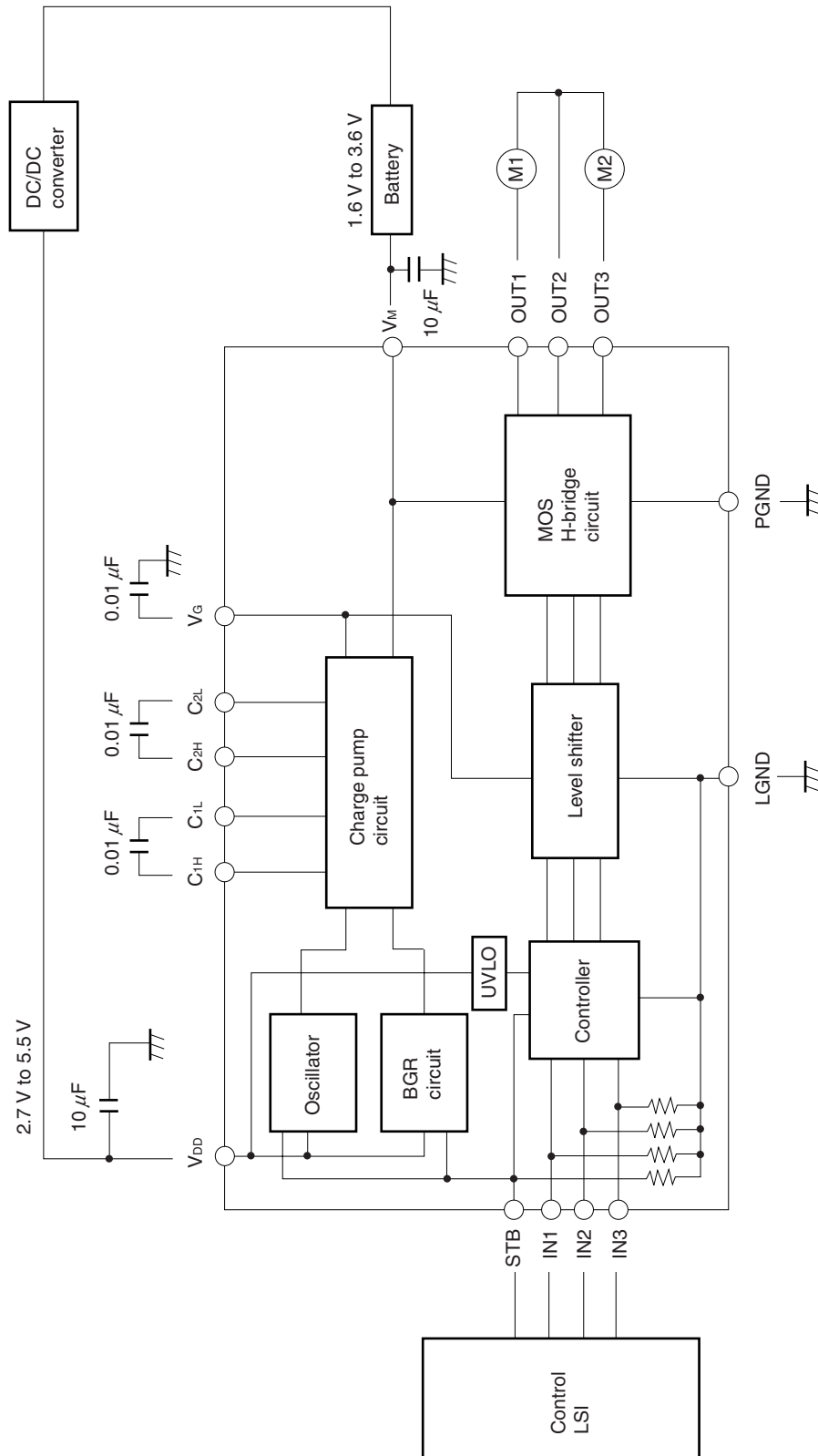


CHARACTERISTICS CURVES



EXAMPLE OF STANDARD CONNECTION

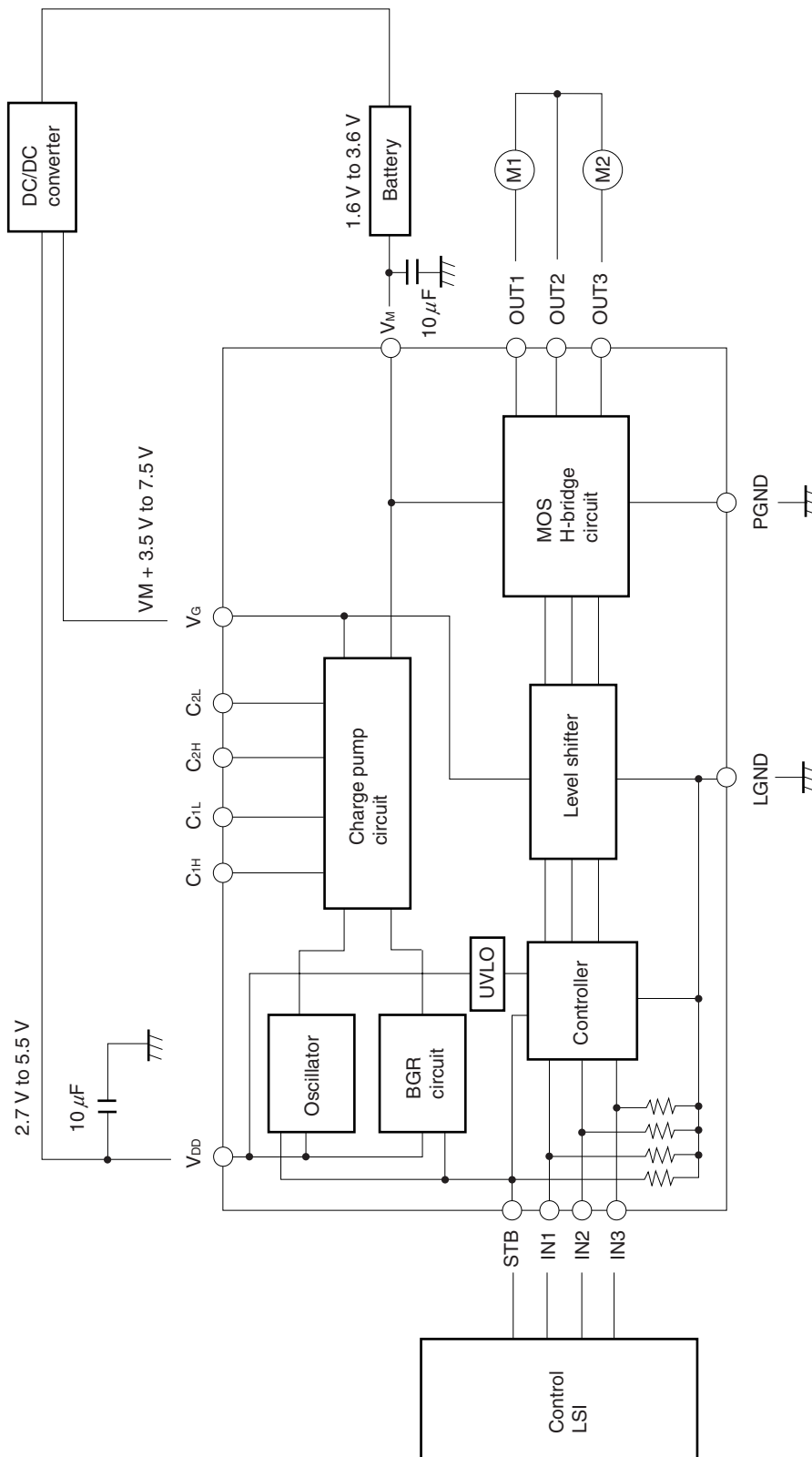
(1) When charge pump used



- Remarks 1.** To reduce the noise, inserting a tantalum capacitor of about 10 μs in the power supply line is recommended.
- 2.** To prevent the noise wraparound, connecting LGND and PGND separately (one point grounding) is recommended.



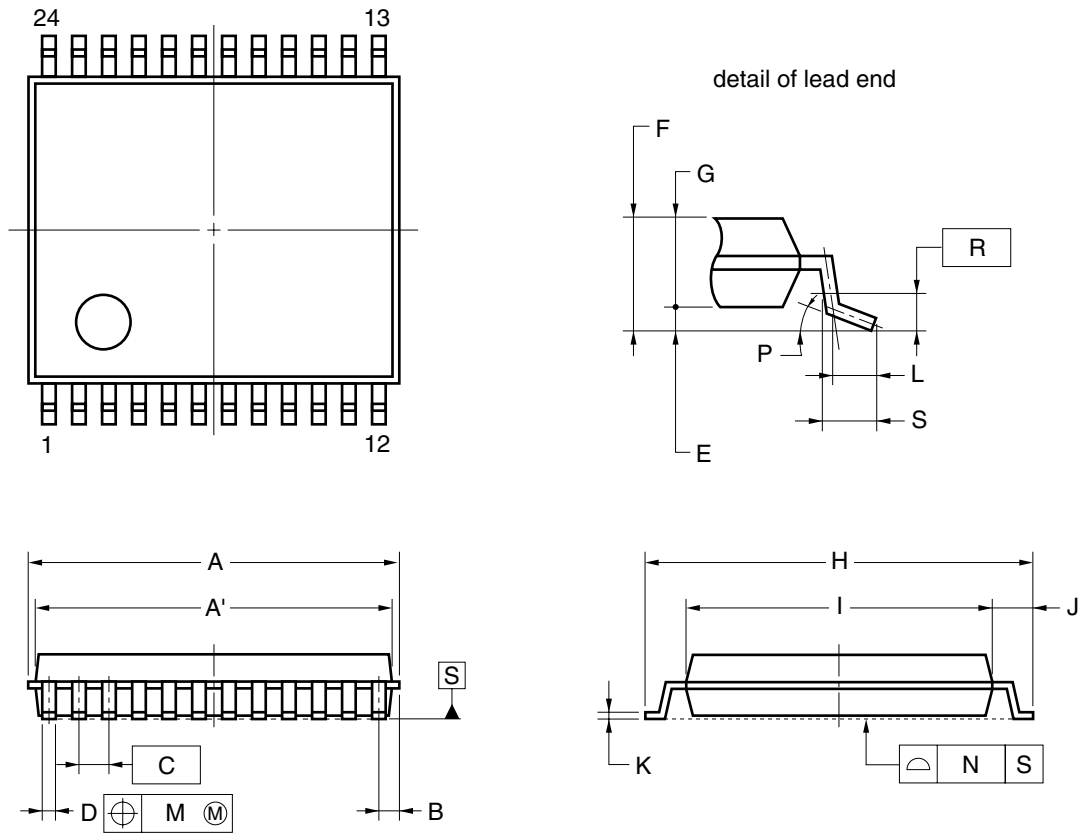
(2) When VG is externally input



- Remarks 1.** To reduce the noise, inserting a tantalum capacitor of about 10 μs in the power supply line is recommended.
- 2.** To prevent the noise wraparound, connecting LGND and PGND separately (one point grounding) is recommended.

PACKAGE DRAWING

24-PIN PLASTIC TSSOP (5.72 mm (225))



NOTE

Each lead centerline is located within 0.10 mm of its true position (T.P.) at maximum material condition.

ITEM	MILLIMETERS
A	6.65±0.10
A'	6.5±0.1
B	0.575
C	0.5 (T.P.)
D	0.22±0.05
E	0.1±0.05
F	1.2 MAX.
G	1.0±0.05
H	6.4±0.1
I	4.4±0.1
J	1.0±0.1
K	0.145±0.025
L	0.5
M	0.10
N	0.08
P	3° <sup>+5°</sup> <sub>-3°</sub>
R	0.25
S	0.6±0.15
<b>S24MA-50-6A5</b>	

**RECOMMENDED SOLDERING CONDITIONS**

The μPD16886 should be soldered and mounted under the following recommended conditions.

For details of the recommended soldering conditions, refer to the document **Semiconductor Device Mounting Technology Manual (C10535E)**. For soldering methods and conditions other than those recommended below, contact an NEC sales representative.

**Surface Mounting Type Soldering Conditions**

Soldering Method	Soldering Conditions	Recommended Condition Symbol
Infrared reflow	Package peak temperature: 235°C, Time: 30 seconds max. (at 210°C or higher), Count: Three times or less, Exposure limit: None, Flux: Rosin-based flux with low chlorine content (chlorine 0.2Wt% or below) is recommended	IR35-00-3
VPS	Package peak temperature: 215°C, Time: 40 seconds max. (at 200°C or higher), Count: Three times or less, Exposure limit: None, Flux: Rosin-based flux with low chlorine content (chlorine 0.2Wt% or below) is recommended	VP15-00-3
Wave soldering	Package peak temperature: 260°C, Time: 10 seconds max., Preheating temperature: 120°C or lower, Count: Once, Flux: Rosin-based flux with low chlorine content (chlorine 0.2Wt% or below) is recommended	WS60-00-1

**Note** Do not use different soldering methods together.

[MEMO]

[MEMO]

[MEMO]

**NOTES FOR CMOS DEVICES****① PRECAUTION AGAINST ESD FOR SEMICONDUCTORS**

Note:

Strong electric field, when exposed to a MOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop generation of static electricity as much as possible, and quickly dissipate it once, when it has occurred. Environmental control must be adequate. When it is dry, humidifier should be used. It is recommended to avoid using insulators that easily build static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work bench and floor should be grounded. The operator should be grounded using wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions need to be taken for PW boards with semiconductor devices on it.

**② HANDLING OF UNUSED INPUT PINS FOR CMOS**

Note:

No connection for CMOS device inputs can be cause of malfunction. If no connection is provided to the input pins, it is possible that an internal input level may be generated due to noise, etc., hence causing malfunction. CMOS devices behave differently than Bipolar or NMOS devices. Input levels of CMOS devices must be fixed high or low by using a pull-up or pull-down circuitry. Each unused pin should be connected to  $V_{DD}$  or GND with a resistor, if it is considered to have a possibility of being an output pin. All handling related to the unused pins must be judged device by device and related specifications governing the devices.

**③ STATUS BEFORE INITIALIZATION OF MOS DEVICES**

Note:

Power-on does not necessarily define initial status of MOS device. Production process of MOS does not define the initial operation status of the device. Immediately after the power source is turned ON, the devices with reset function have not yet been initialized. Hence, power-on does not guarantee out-pin levels, I/O settings or contents of registers. Device is not initialized until the reset signal is received. Reset operation must be executed immediately after power-on for devices having reset function.

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