NEC

MOS INTEGRATED CIRCUIT

μPD16886

MONOLITHIC 1.5-CHANNEL H BRIDGE DRIVER CIRCUIT FOR CAMERAS

DESCRIPTION

The μPD16886 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 A During continuous operation
  $I_{D(pulse)}$ = 2.8 A PW ≤ 20 ms, during single operation
  $I_{D(pulse)}$ = 2.2 A PW ≤ 200 ms, during single operation
- On-chip 1.5-channel H bridge circuit
- Low on-resistance R_{ON} = 0.5 Ω 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
μPD16886MA-6A5	24-pin plastic TSSOP (5.72 mm (225))

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Not all devices/types available in every country. Please check with local NEC representative for availability and additional information.

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ABSOLUTE MAXIMUM RATINGS

(T_A = 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_{DD}		−0.5 to +6.0	V
	V_M	When charge pump operating	−0.5 to +4.0	V
		At V_G external input	−0.5 to +6.0	
V_G pin apply voltage	V_G	At V_G external input	8.0	V
Input voltage	V_{IN}		−0.5 to V_{DD} + 0.5	V
Output current (DC)	$I_{D(DC)}$	During successive operation	±1.0	A
Output current (pulse)	$I_{D(pulse)}$	PW < 20 ms, single pulse	±2.8	A
Output current (pulse)	$I_{D(pulse)}$	PW < 200 ms, single pulse	±2.2	A
Power consumption	P_T		0.7	W
Peak junction temperature	$T_{J(MAX)}$		150	°C
Storage temperature	T_{stg}		−55 to +150	°C

RECOMMENDED OPERATING CONDITIONS

(T_A = 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_{DD}		2.7		5.5	V
	V_M		1.6		3.6	V
V_G pin apply voltage	V_G		V_M + 3.5		7.5	V
Output current (DC)	$I_{D(DC)}$	During successive operation			0.8	A
Output current (pulse)	$I_{D(pulse)}$	PW < 20 ms, single pulse			2.5	A
Output current (pulse)	$I_{D(pulse)}$	PW < 200 ms, single pulse			2.0	A
Charge pump capacitor capacitance	C_1 to C_3			0.01		μF
Operating ambient temperature	T_A		−20		+75	°C
Peak junction temperature	$T_{J(MAX)}$				125	°C

ELECTRICAL SPECIFICATIONS (UNLESS OTHERWISE SPECIFIED, T_A = 25°C, V_{DD} = V_M = 3.0 V)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
V_{DD} pin current	I_{DD}	STB = V_{DD}			2.0	mA
	$I_{DD(STB)}$	STB = GND			1.0	μA
V_M pin current in off state	I_{MOFF}	Control pin at low level			1.0	μA
Input voltage, high	V_{IH}		1.8		V_{DD}	V
Input voltage, low	V_{IL}				0.8	V
Input pull-down resistor	R_{IND}			200		kΩ
Output on-resistance	R_{ON}	−20°C ≤ T_A ≤ 75°C I_D = 0.8 A C_1 = C_2 = C_3 = 0.01 μF		0.35	0.5	Ω
Low voltage detection voltage	V_{DDS}		0.8		2.5	V
Charge pump circuit turn-on time	t_{ONC}	C_1 = C_2 = C_3 = 0.01 μF I_D = 0.8 A, see **Figures 1** and **2**			1.0	ms
H bridge circuit turn-on time	t_{ON}				5.0	μs
H bridge circuit turn-off time	t_{OFF}				5.0	μs

The output is high impedance during low-voltage detection.

The V_G pin voltage when using the charge pump is $V_G \fallingdotseq V_M$ + 3.6 V.

Figure 1. Charge Pump Characteristics Waveform

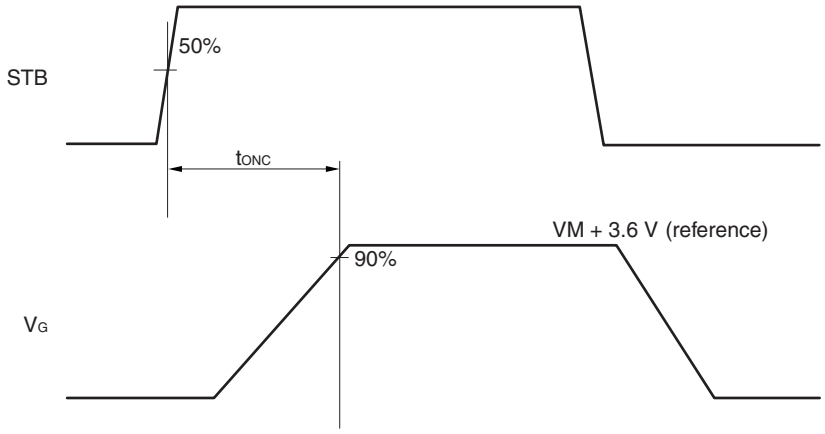
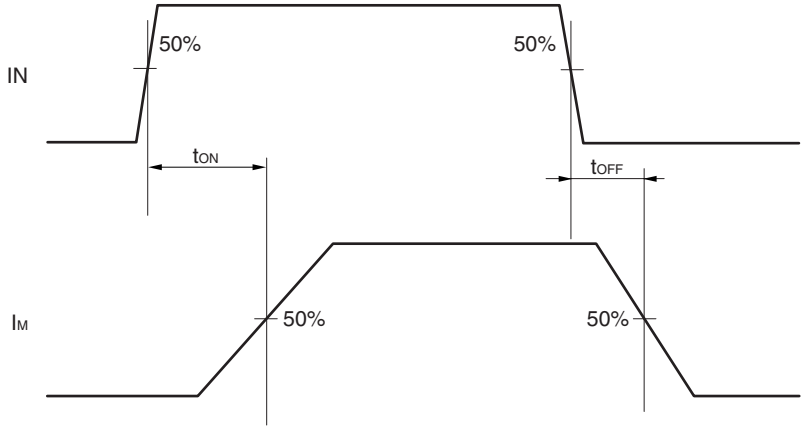
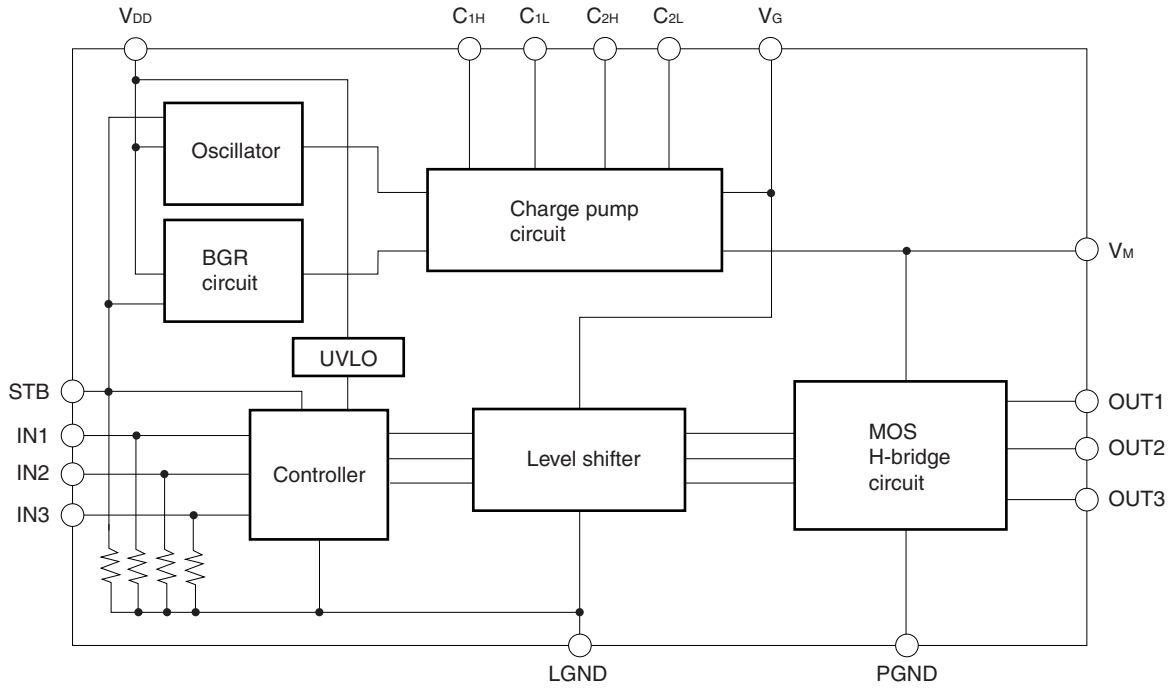


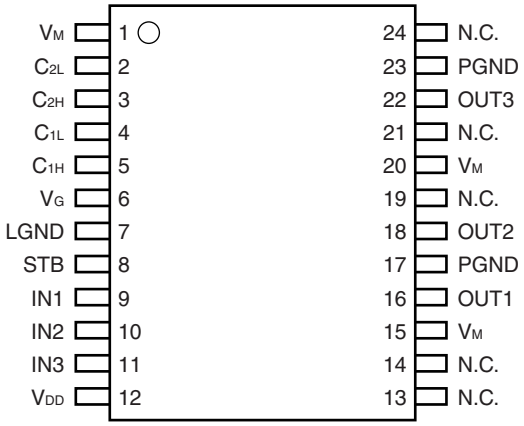
Figure 2. Switching Characteristics Waveform



BLOCK DIAGRAM

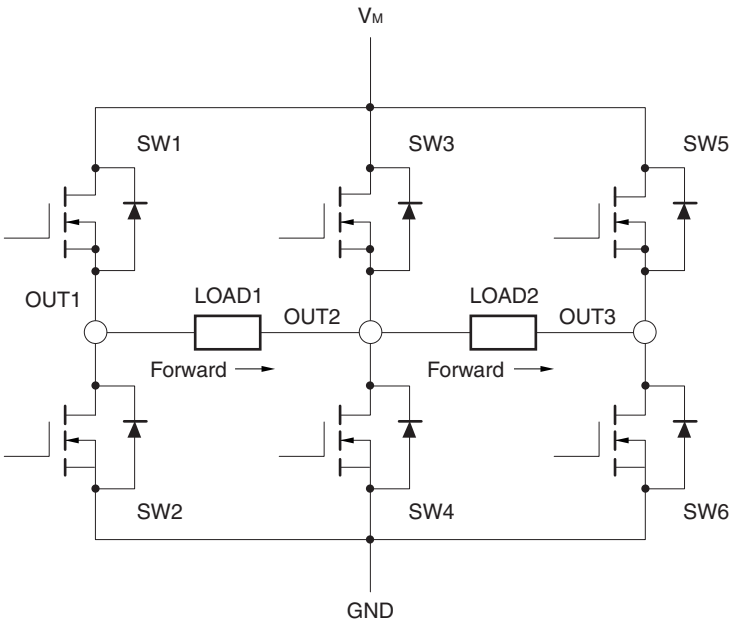


PIN CONFIGURATION



Pin No.	Pin Name	Pin Function	Pin No.	Pin Name	Pin Function
1	V_M	Motor block supply voltage pin	13	N.C.	Unused pin
2	C_{2L}	Charge pump capacitor connection pin	14	N.C.	Unused pin
3	C_{2H}	Charge pump capacitor connection pin	15	V_M	Motor block supply voltage pin
4	C_{1L}	Charge pump capacitor connection pin	16	OUT1	H bridge output pin
5	C_{1H}	Charge pump capacitor connection pin	17	PGND	Output block GND pin
6	V_G	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_M	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_{DD}	Control block supply voltage pin	24	N.C.	Unused pin

FUNCTION TABLE (OUTPUT BLOCK CONNECTION)

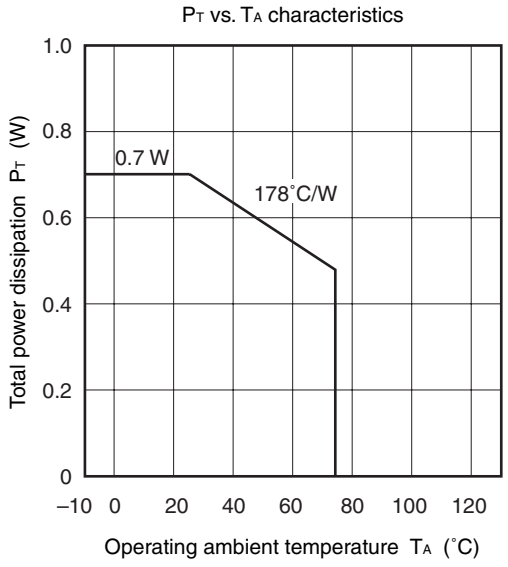


(Truth Table)

Input Signal				Circuit Operation	Current Route
IN1	IN2	IN3	STB		
L	H	L	H	1 ch forward	$V_M \rightarrow$ OUT1 $\rightarrow$ LOAD1 $\rightarrow$ OUT2 $\rightarrow$ GND
L	L	H	H	1 ch reverse	$V_M \rightarrow$ OUT2 $\rightarrow$ LOAD1 $\rightarrow$ OUT1 $\rightarrow$ GND
L	H	H	H	1 ch brake	Only SW2 and SW4 are on
H	H	L	H	2 ch forward	$V_M \rightarrow$ OUT2 $\rightarrow$ LOAD2 $\rightarrow$ OUT3 $\rightarrow$ GND
H	L	H	H	2 ch reverse	$V_M \rightarrow$ OUT3 $\rightarrow$ LOAD2 $\rightarrow$ OUT2 $\rightarrow$ 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

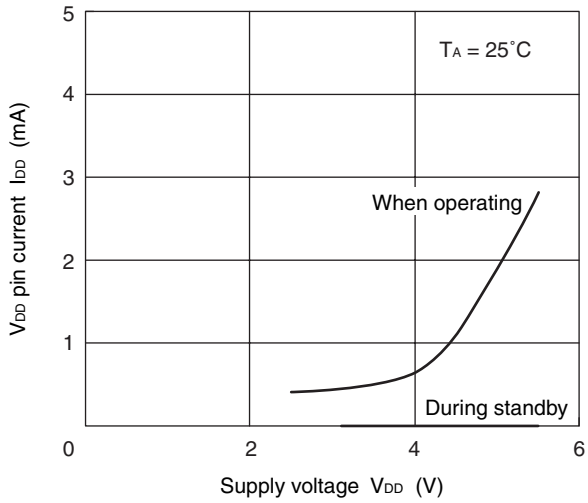
Unused switches (example: SW1 and SW2 at 2 ch driving) are high impedance.

CHARACTERISTICS CURVES

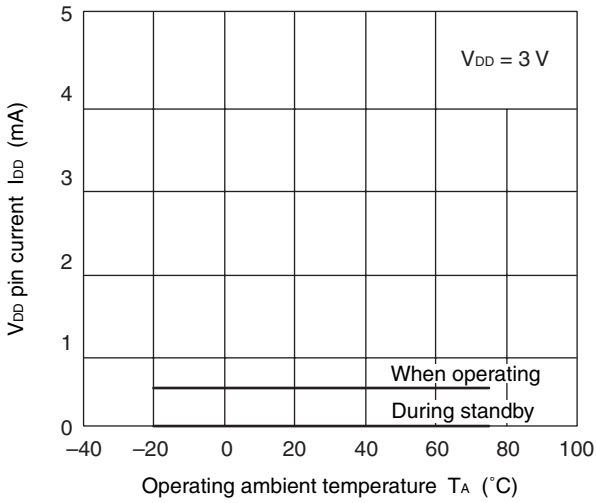


CHARACTERISTICS CURVES

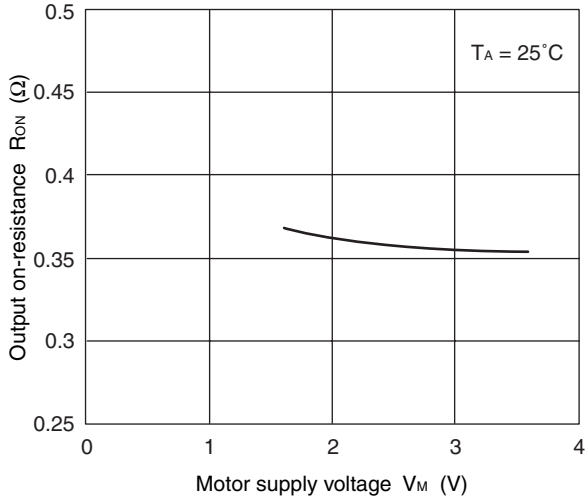
I_{DD} vs. V_{DD} characteristics



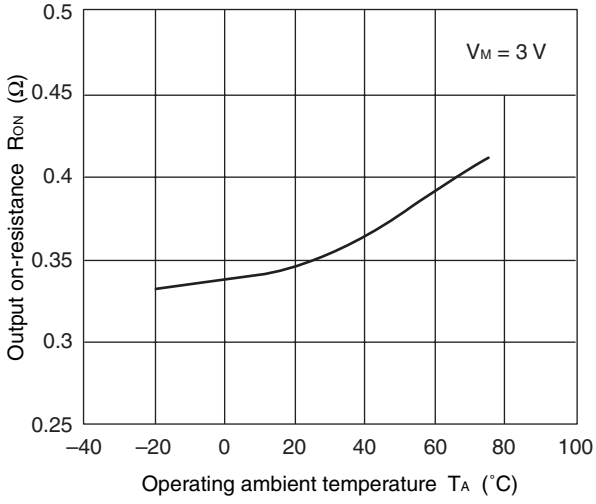
I_{DD} vs. T_A characteristics



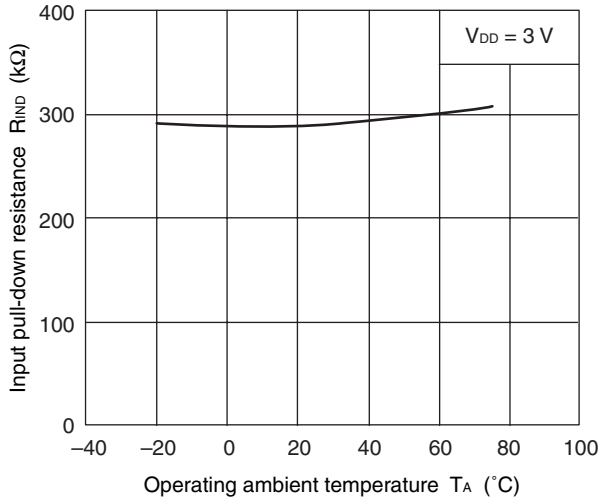
R_{ON} vs. V_M characteristics



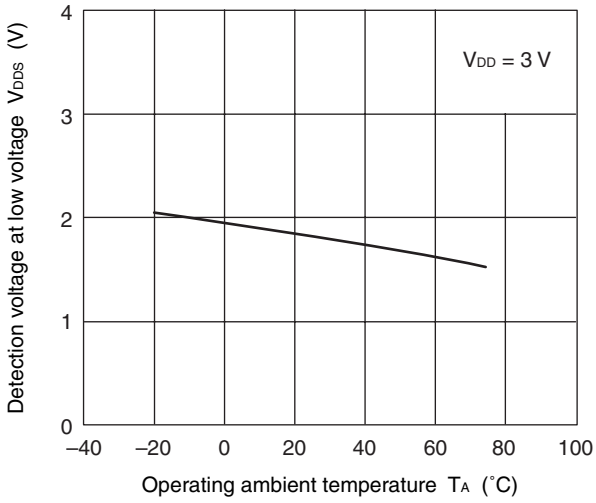
R_{ON} vs. T_A characteristics



R_{IND} vs. T_A characteristics

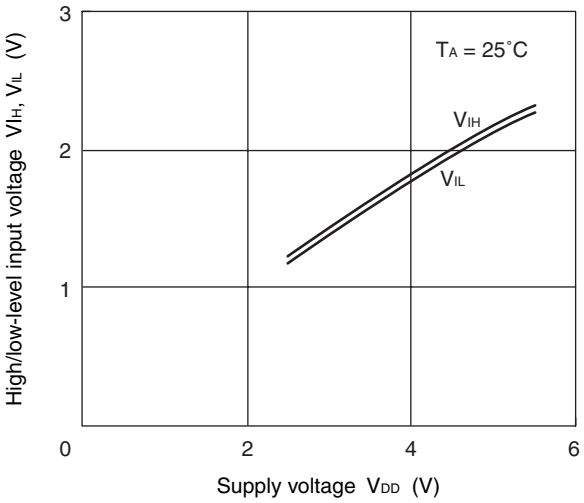


V_{DDS} vs. T_A characteristics

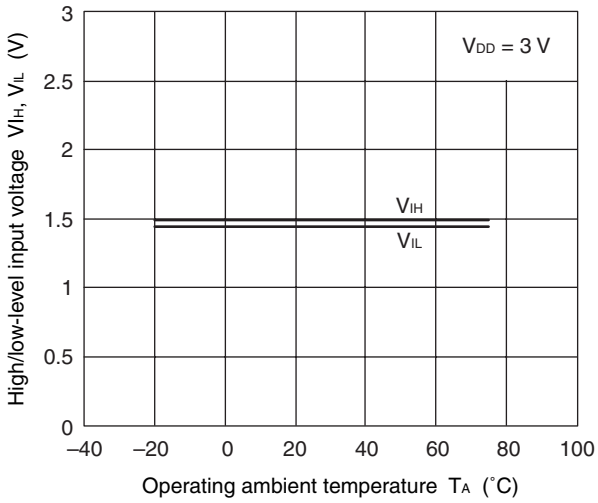


CHARACTERISTICS CURVES

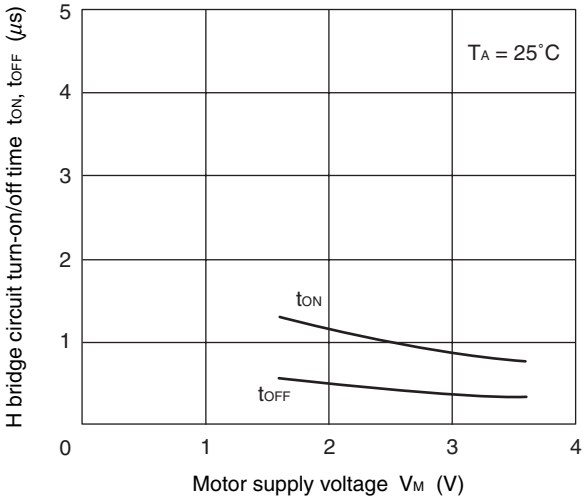
V_{IH}, V_{IL} vs. V_{DD} characteristics



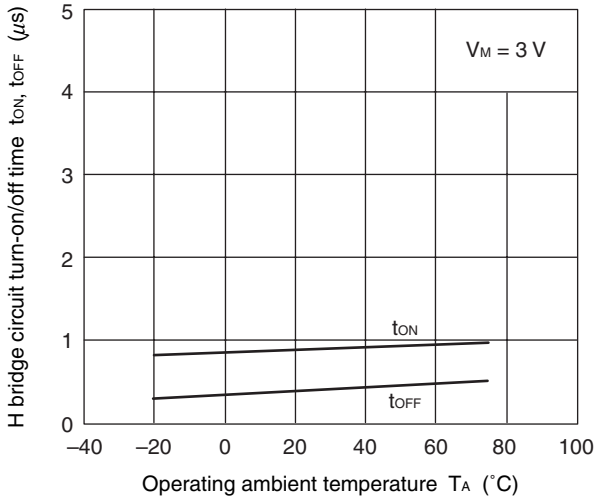
V_{IH}, V_{IL} vs. T_A characteristics



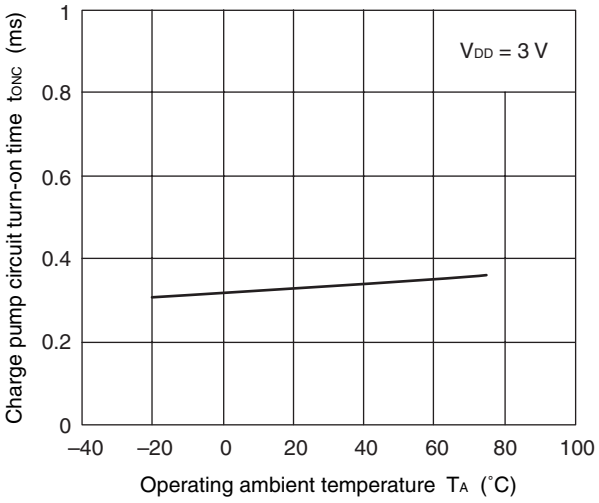
t_{ON}, t_{OFF} vs. V_M characteristics



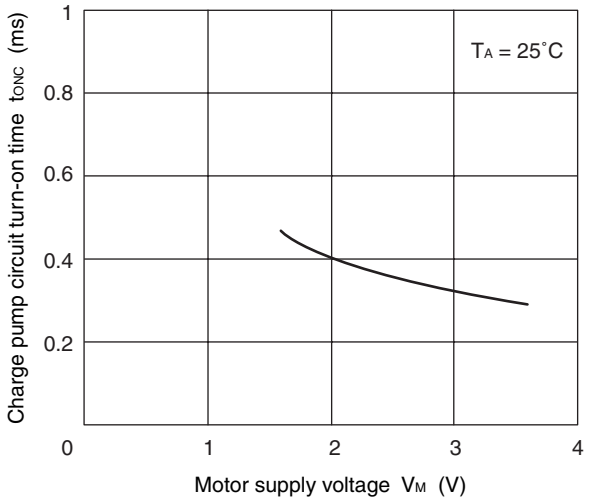
t_{ON}, t_{OFF} vs. T_A characteristics



t_{ONC} vs. T_A characteristics

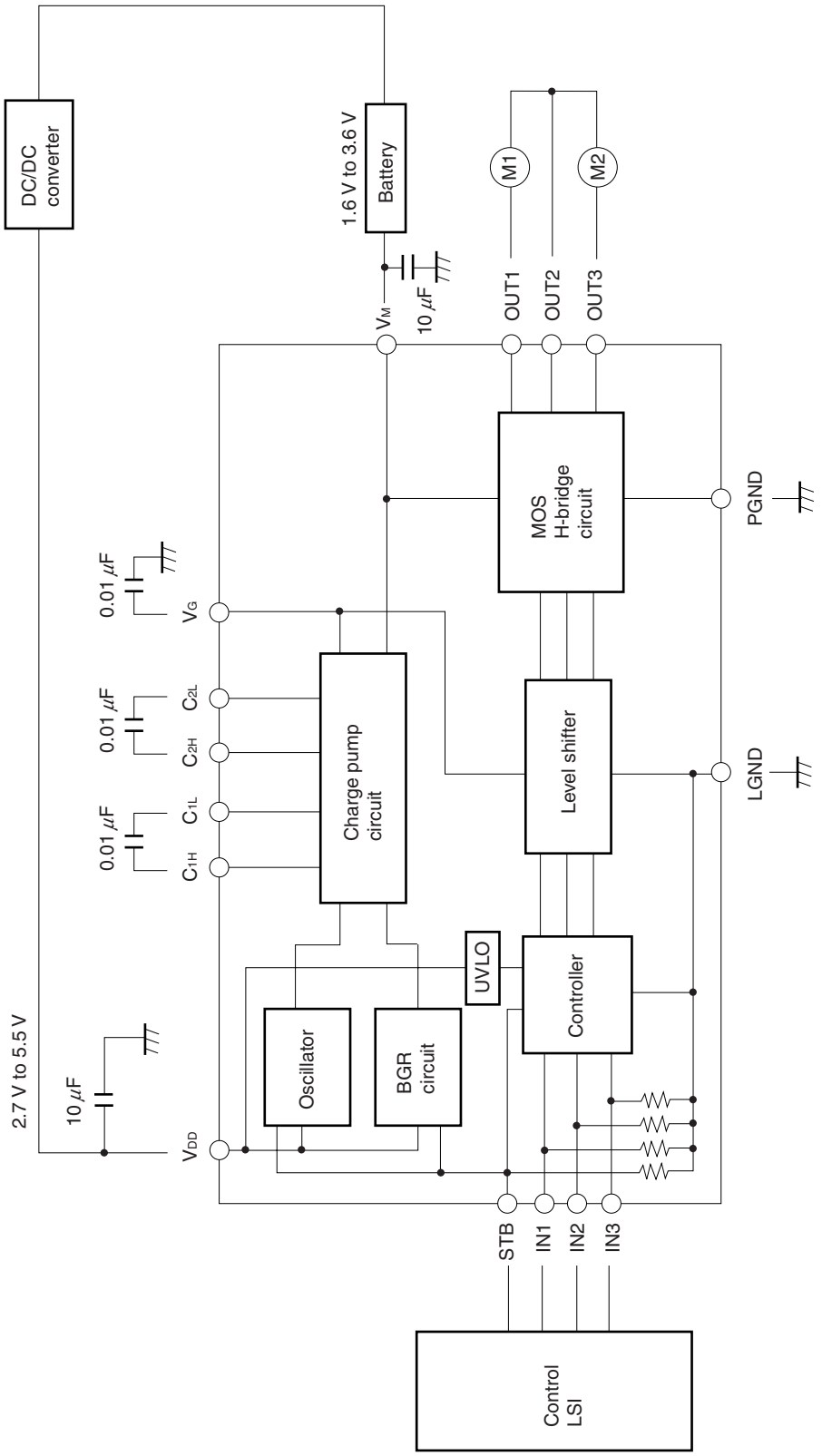


T_{ONC} vs. V_M characteristics



EXAMPLE OF STANDARD CONNECTION

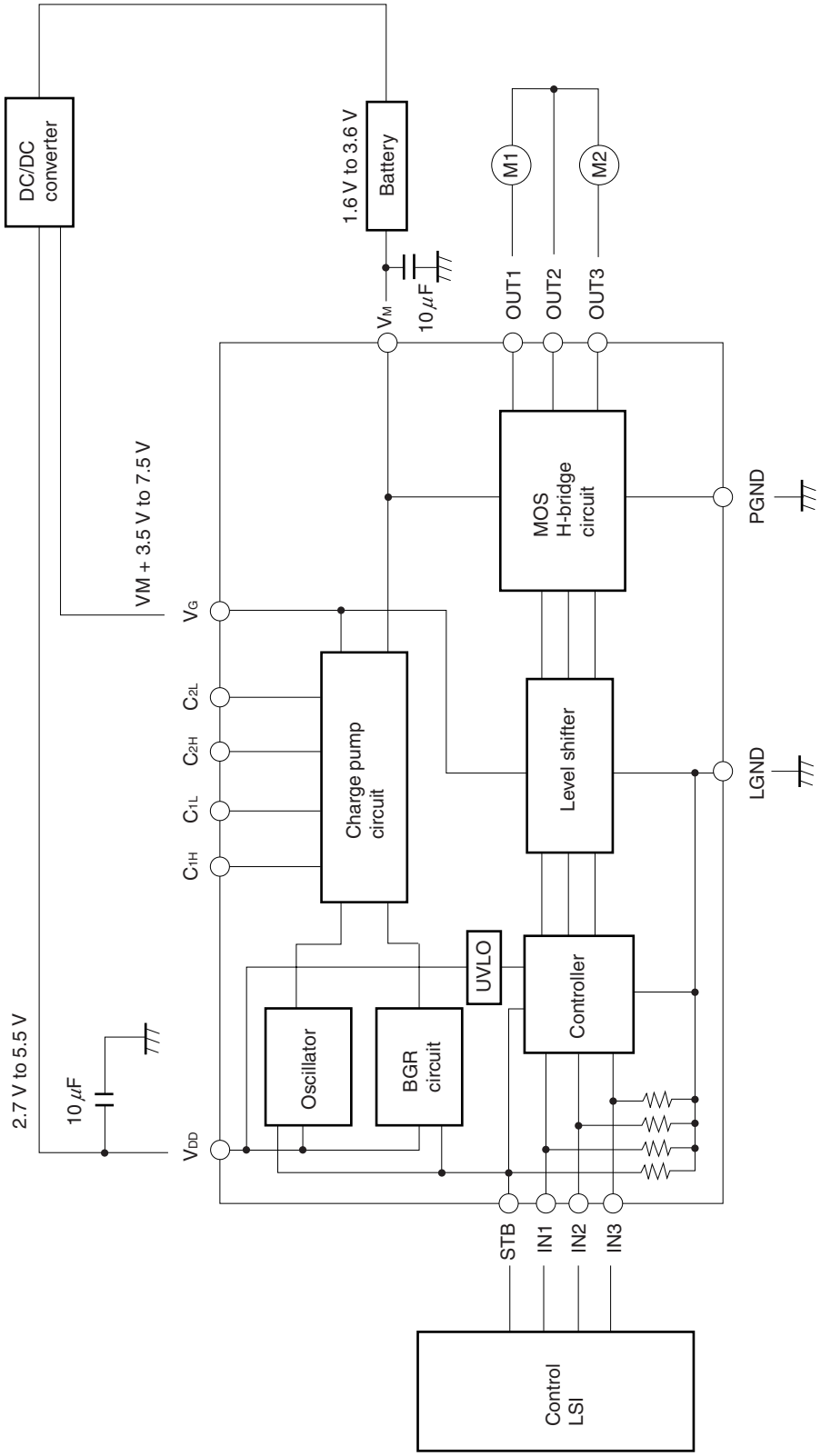
(1) When charge pump used



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

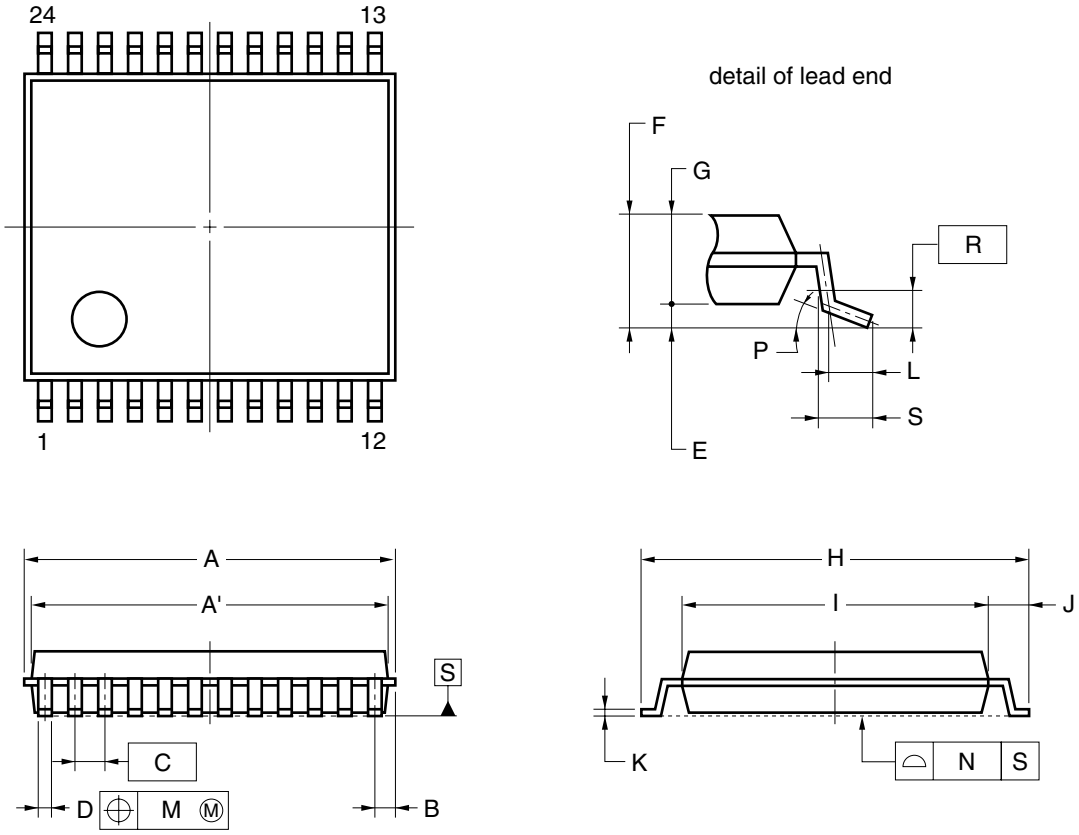


Remarks 1. To reduce the noise, inserting a tantalum capacitor of about 10 μs in the power supply line is recommended.

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	$3^{\circ}{}^{+5^{\circ}}_{-3^{\circ}}$
R	0.25
S	0.6±0.15

S24MA-50-6A5

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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