

MONOLITHIC QUAD H-BRIDGE DRIVER CIRCUIT

DESCRIPTION

The μ PD16877 is monolithic quad H-bridge driver LSI which uses power MOSFETs in the output stages. By using the MOS process, this driver IC has substantially improved saturation voltage and power consumption as compared with conventional driver circuits using bipolar transistors.

By eliminating the charge pump circuit, the current during power-OFF is drastically decreased.

In addition, a low-voltage malfunction prevention circuit is also provided that prevents the IC from malfunctioning when the supply voltage drops.

As the package, a 24-pin plastic TSSOP is adopted to enable the creation of compact, slim application sets.

This driver IC can drive two stepping motor at the same time, and is ideal for driving stepping motors in the lens of a camcorder.

FEATURES

- Four H bridge circuits employing power MOSFETs
- Low current consumption by eliminating charge pump
 - V_M pin current when power-OFF: 10 μ A MAX. V_{DD} pin current: 10 μ A MAX.
- Input logic frequency: 100 kHz
- 3-V power supply
 - Minimum operating supply voltage: 2.5 V
- Low voltage malfunction prevention circuit
- 24-pin plastic TSSOP (5.72 mm (225))

ORDERING INFORMATION

Part Number	Package
μ PD16877MA-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.

ABSOLUTE MAXIMUM RATINGS ($T_A = 25^\circ\text{C}$)**When mounted on a glass epoxy board (10 cm × 10 cm × 1 mm, 15% copper foil)**

Parameter	Symbol	Condition	Rating	Unit
Control block supply voltage	V_{DD}		-0.5 to +6.0	V
Output block supply voltage	V_M		-0.5 to +6.0	V
Input voltage	V_{IN}		-0.5 to $V_{DD} + 0.5$	V
Output terminal voltage	V_{OUT}		6.2	V
Output current	$I_{D(DC)}$	DC	± 0.3	A/ch
	$I_{D(pulse)}$	$PW \leq 10 \text{ ms}$, Duty $\leq 5\%$	± 0.7	A/ch
Power consumption	P_T		0.7	W
Peak junction temperature	$T_{CH(MAX)}$		150	$^\circ\text{C}$
Storage temperature range	T_{stg}		-55 to +150	$^\circ\text{C}$

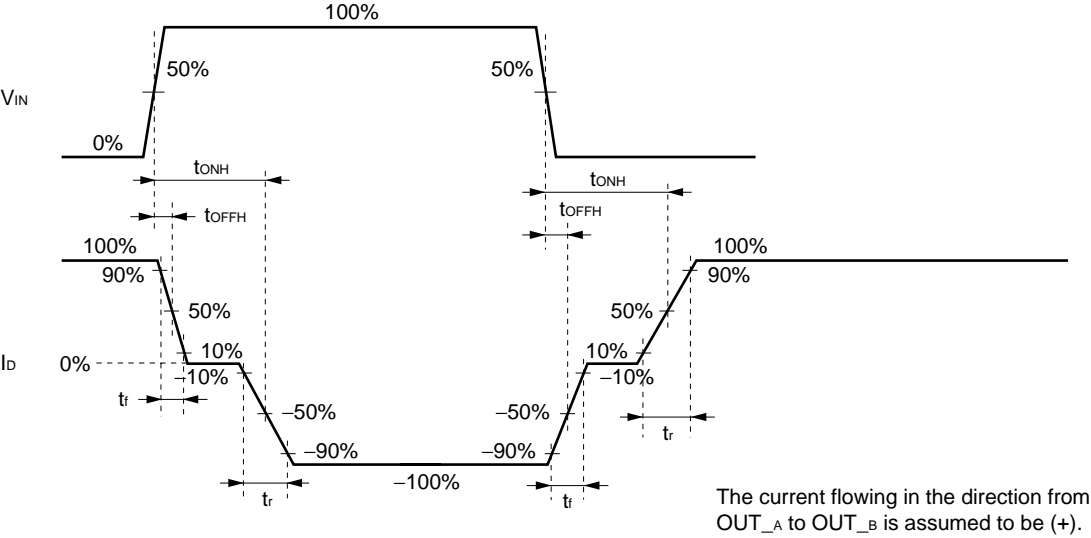
RECOMMENDED OPERATING CONDITIONS**When mounted on a glass epoxy board (10 cm × 10 cm × 1 mm, 15% copper foil)**

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Control block supply voltage	V_{DD}		2.5		5.5	V
Output block supply voltage	V_M		2.7		5.5	V
Output current	$I_{D(DC)}$	DC	-0.2		+0.2	A
Operating frequency	f_{IN}	IN, EN terminal			100	kHz
Operating temperature range	T_A		-10		85	$^\circ\text{C}$
Peak junction temperature	$T_{CH(MAX)}$				125	$^\circ\text{C}$

CHARACTERISTICS (Unless otherwise specified, $V_{DD} = V_M = 3 \text{ V}$, $T_A = 25^\circ\text{C}$)

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Off state V_M pin current	$I_{M(OFF)}$	All control terminal: L level			10	μA
V_{DD} pin current	I_{DD}	All control terminal: L level			10	μA
High level input current	I_{IH}	$V_{IN} = V_{DD}$			0.06	mA
Low level input current	I_{IL}	$V_{IN} = 0 \text{ V}$	-1.0			μA
Input pull down resistance	R_{IND}		50		200	$\text{k}\Omega$
High level input voltage	V_{IH}	$2.5 \text{ V} \leq V_{DD} \leq 5.5 \text{ V}$	$0.7 \times V_{DD}$		$V_{DD} + 0.3$	V
Low level input voltage	V_{IL}		-3.0		$0.3 \times V_{DD}$	V
H-bridge ON resistance	R_{ON}	$2.5 \text{ V} \leq V_M$, $V_{DD} \leq 5.5 \text{ V}$ Upper + lower			3.0	Ω
Low voltage malfunction prevention circuit operating voltage	V_{DDS1}	$V_M = 5 \text{ V}$ $-10^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$	0.8		2.5	V
	V_{DDS2}	$V_M = 3 \text{ V}$ $-10^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$	0.65		2.5	V
H bridge output turn-on time	t_{ONH}	$R_M = 20 \Omega$ Figure 1		0.7	20	μs
H bridge output turn-off time	t_{OFFH}			0.2	0.5	μs
H bridge output rise time	t_r		0.1	0.4	1.0	μs
H bridge output fall time	t_f			70	200	ns

Figure 1. Switching time condition



FUNCTION TABLE

Channel 1

EN ₁	IN ₁	OUT _{1A}	OUT _{1B}
H	L	H	L
H	H	L	H
L	L	Z	Z
L	H	Z	Z

Channel 2

EN ₂	IN ₂	OUT _{2A}	OUT _{2B}
H	L	H	L
H	H	L	H
L	L	Z	Z
L	H	Z	Z

Channel 3

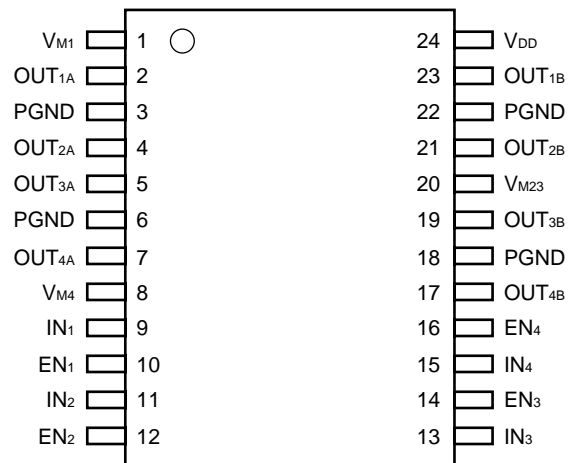
EN ₃	IN ₃	OUT _{3A}	OUT _{3B}
H	L	H	L
H	H	L	H
L	L	Z	Z
L	H	Z	Z

Channel 4

EN ₄	IN ₄	OUT _{4A}	OUT _{4B}
H	L	H	L
H	H	L	H
L	L	Z	Z
L	H	Z	Z

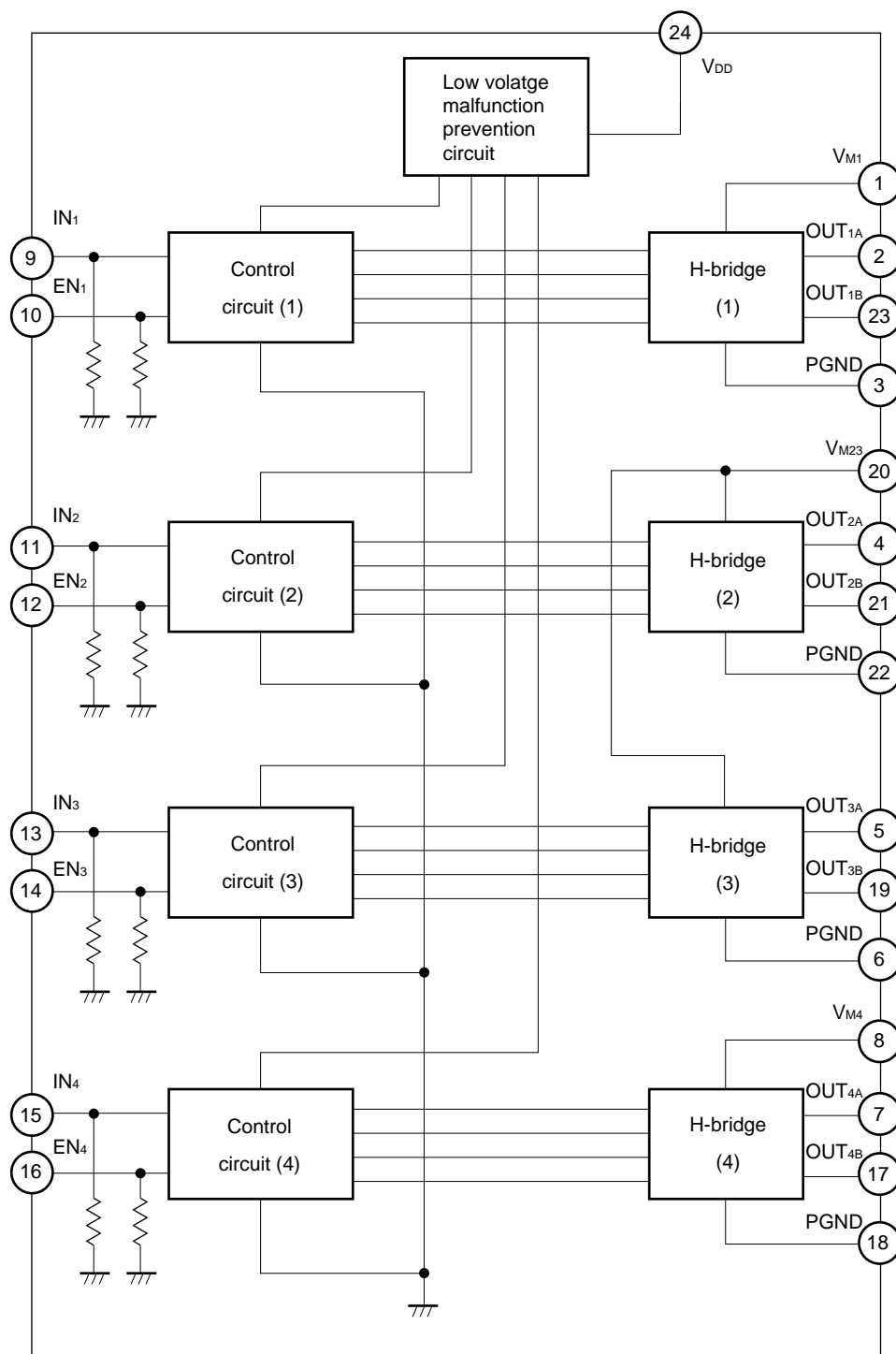
H: High-level, L: Low-level, Z: High impedance

PIN CONNECTION



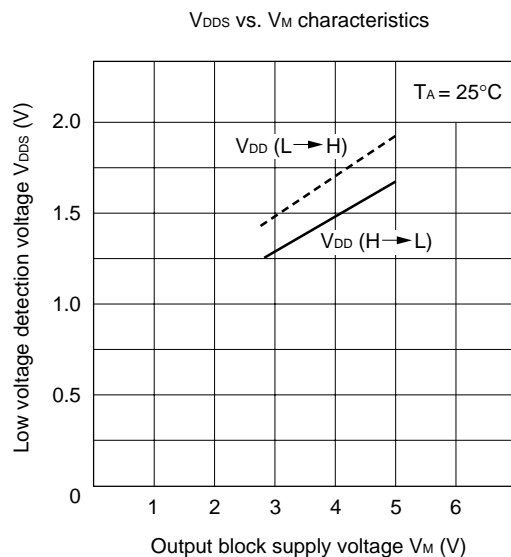
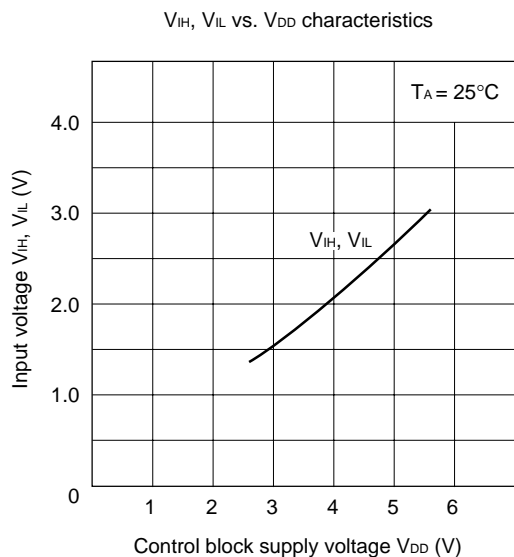
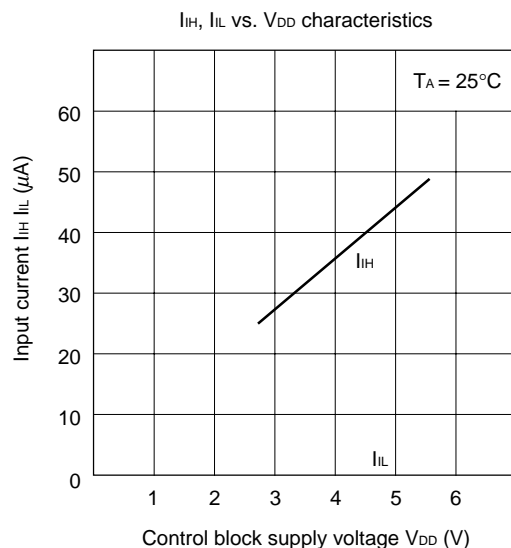
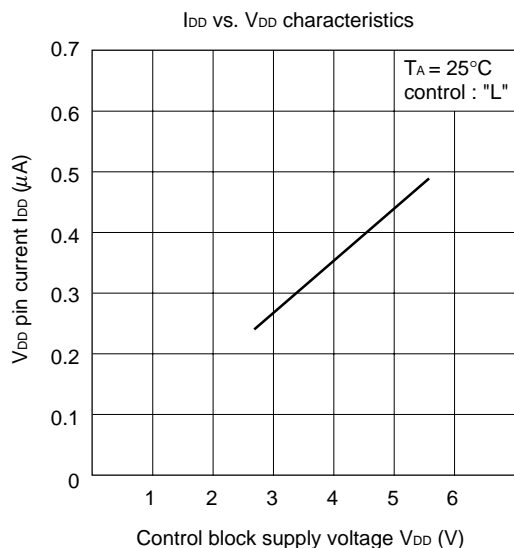
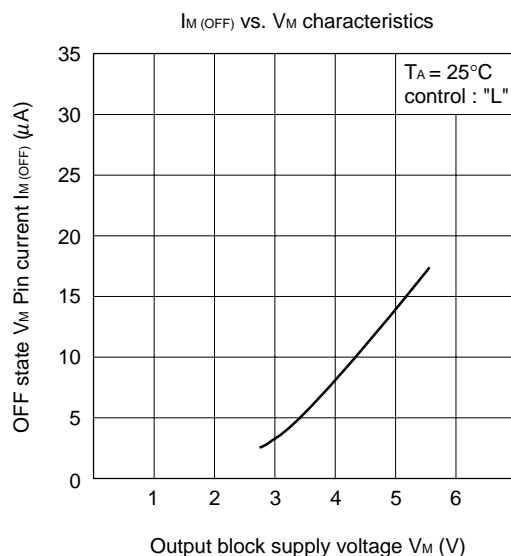
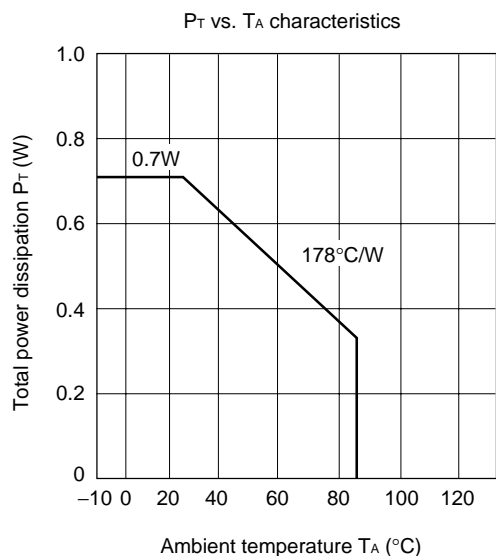
Pin No.	Pin name	Pin function	Pin No.	Pin name	Pin function
1	VM1	Output block supply voltage input terminal	13	IN3	Control terminal (channel 3)
2	OUT1A	Output terminal	14	EN3	Enable terminal (channel 3)
3	PGND	Ground terminal	15	IN4	Control terminal (channel 4)
4	OUT2A	Output terminal	16	EN4	Enable terminal (channel 4)
5	OUT3A	Output terminal	17	OUT4B	Output terminal
6	PGND	Ground terminal	18	PGND	Ground terminal
7	OUT4A	Output terminal	19	OUT3B	Output terminal
8	VM4	Output block supply voltage input terminal	20	VM23	Output block supply voltage input terminal
9	IN1	Control terminal (channel 1)	21	OUT2B	Output terminal
10	EN1	Enable terminal (channel 1)	22	PGND	Ground terminal
11	IN2	Control terminal (channel 2)	23	OUT1B	Output terminal
12	EN2	Enable terminal (channel 2)	24	VDD	Control block supply voltage input terminal

BLOCK DIAGRAM

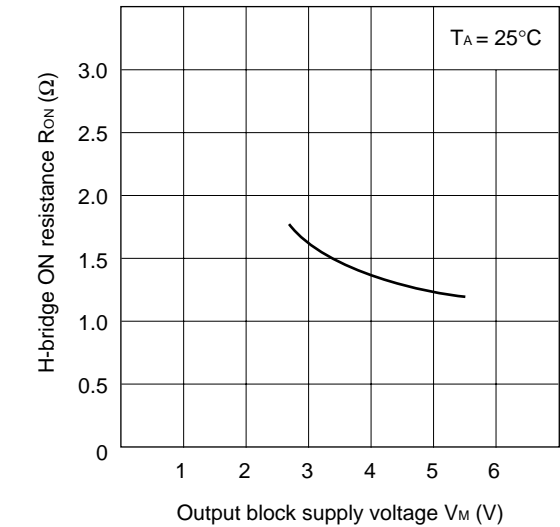


Remark Plural terminal (V_M, PGND) is not only 1 terminal and connect all terminals.

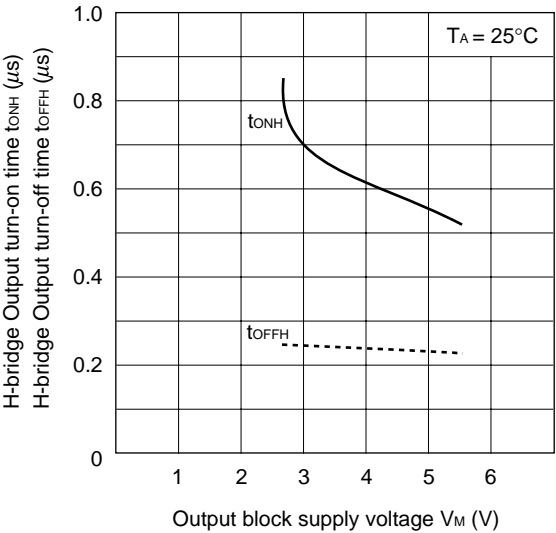
TYPICAL CHARACTERISTICS



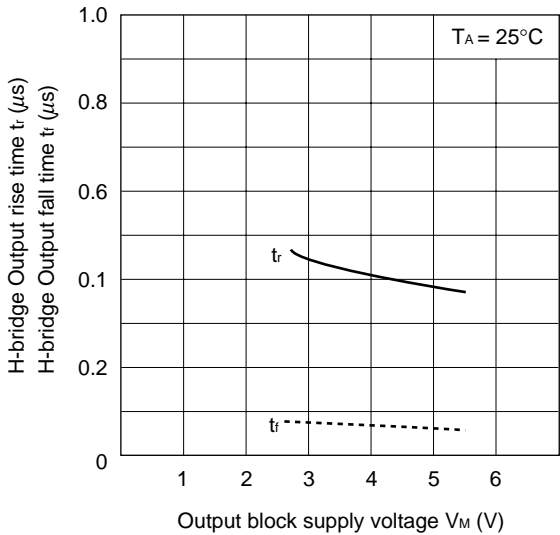
R_{ON} vs. V_M characteristics



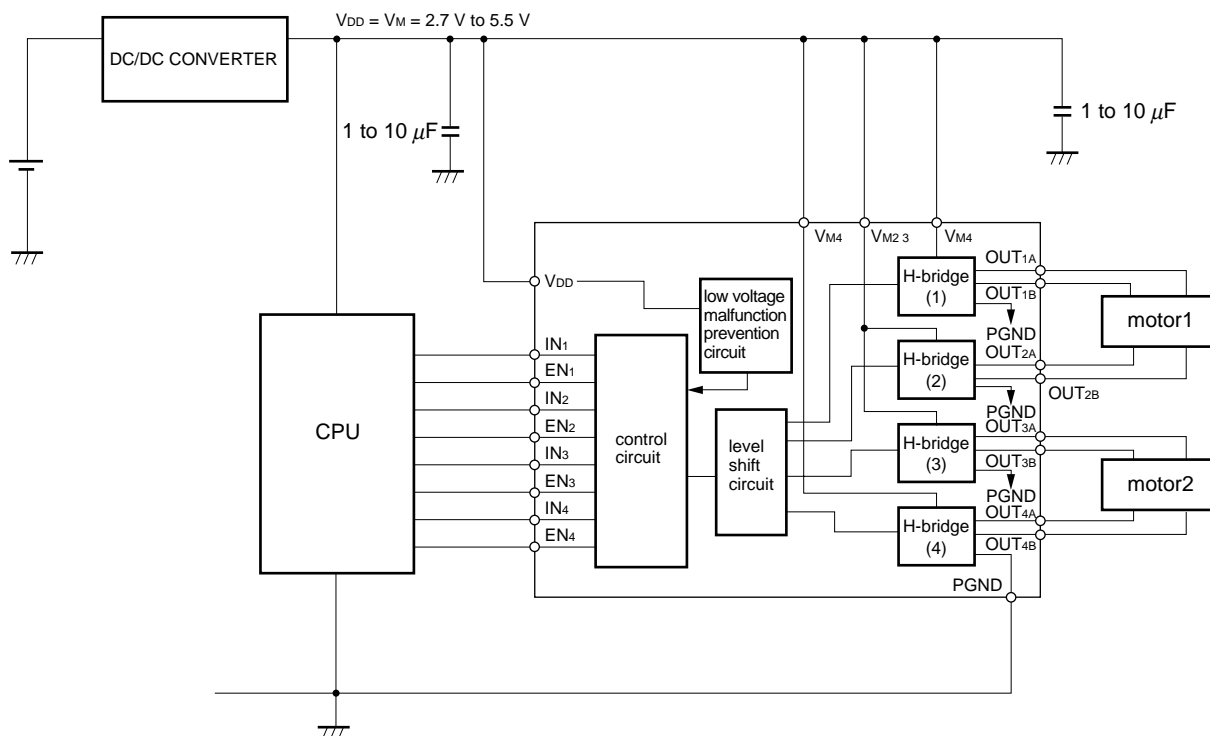
t_{ONH} , t_{OFFH} vs. V_M characteristics



t_r , t_f vs. V_M characteristics

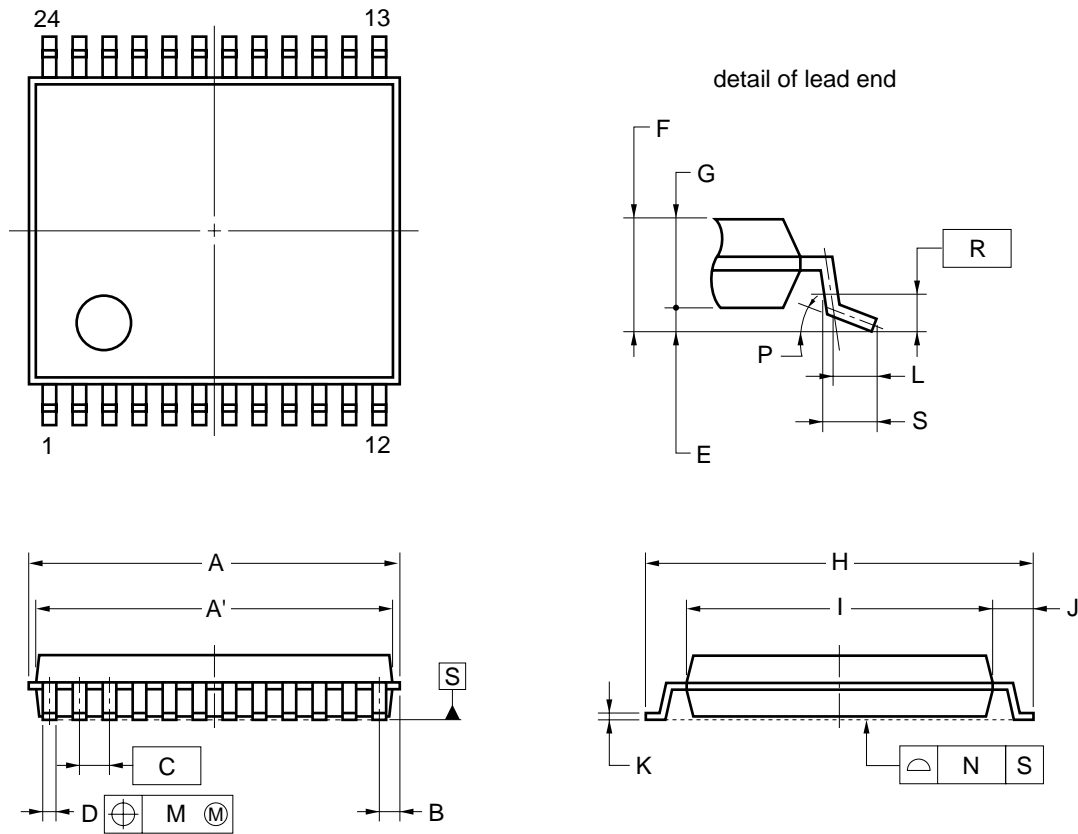


STANDARD CONNECTION EXAMPLE



PACKAGE DIMENSION

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° ^{+5°} _{-3°}
R	0.25
S	0.6±0.15
S24MA-50-6A5	

RECOMMENDED SOLDERING CONDITIONS

Solder this product under the following recommended conditions.

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

For details of the recommended soldering conditions, refer to information document “**Semiconductor Device Mounting Technology Manual**”.

Soldering Method	Soldering Conditions	Recommended Condition Symbol
Infrared reflow	Package peak temperature: 235°C; Time: 30 secs. max. (210°C min.); Number of times: 3 times max; Number of day: none; Flux: Rosin-based flux with little chlorine content (chlorine: 0.2Wt% max.) is recommended.	IR35-00-3
VPS	Package peak temperature: 215°C; Time: 40 secs. max. (200°C min.); Number of times: 3 times max.; Number of day: none; Flux: Rosin-based flux with little chlorine content (chlorine: 0.2 Wt% max.) is recommended.	VP15-00-3
Wave soldering	Package peak temperature: 260°C; Time: 10 secs. max.; Preheating temperature: 120°C max.; Number of times: once; Flux: Rosin-based flux with little chlorine content (chlorine: 0.2 Wt% max.) is recommended.	WS60-00-1

Caution Do not use two or more soldering methods in combination.

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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 - 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)
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