Low Voltage Operation H-Bridge Driver

■FEATURES

- ●Supply Voltage 1.8V to 5.5V
- ●Output Current 1700mA peak (V_{DD}=5V)
  1500mA peak (V_{DD}=3V)
  1200mA peak (V_{DD}=1.8V)
- ●Low Output ON Resistance $R_{ON(H+L)}$=0.23Ω max. (V_{DD}=5V)
  $R_{ON(H+L)}$=0.27Ω max. (V_{DD}=3V)
  $R_{ON(H+L)}$=0.37Ω max. (V_{DD}=1.8V)
- ●Low Quiescent Current 100μA max. (V_{DD}=3V, V_{IN}=3V)
- ●Standby Current 100nA max.
- ●2 Logic Inputs (2-IN) Control
- ●Input Voltage e.g.) 1.8V,2.5V,3.3V,5.0V IF
- ●Protection Circuit UVLO, OCP, TSD
- ●Operating Temperature Range Ta=-40 to 125°C

■GENERAL DESCRIPTION

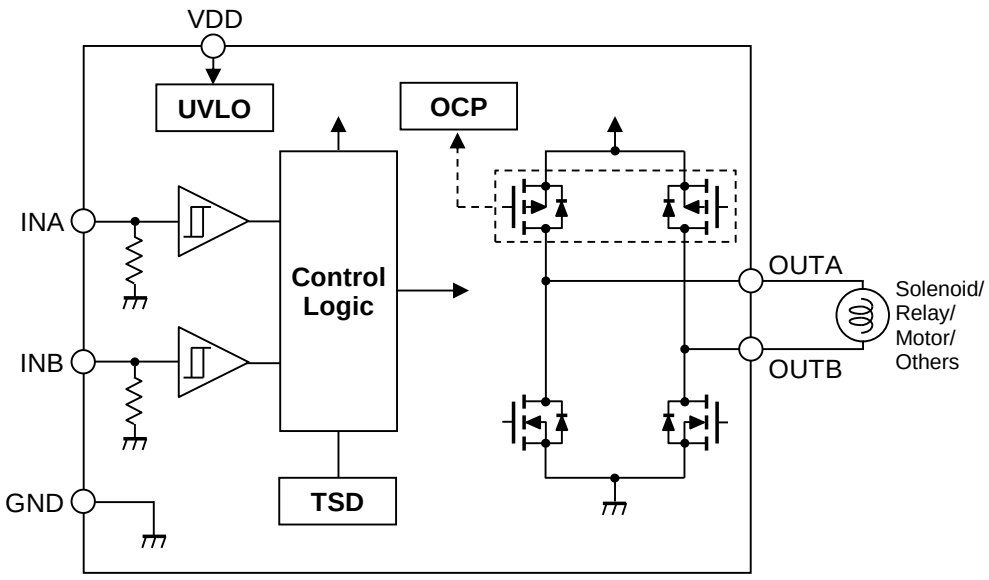
The NJU7386A is a single H-bridge driver IC that features low voltage operation and low ON resistance. The control method is 2 logic Inputs (2-IN) that includes standby mode.
The input block has a low threshold voltage, and it corresponds to signal voltage such as 1.8V / 2.5V / 3.3V / 5.0V regardless of the power supply voltage.
The NJU7386A provides low output ON resistance performance at supply voltage range adequately. Therefore, it is suitable for high current driving actuators such as 2 dry battery driving small actuators and 5V operation latching relays.

■APPLICATION

- ●Cameras
- ●Portable Devices
- ●Consumer Products
- ●Toys
- ●Robotics

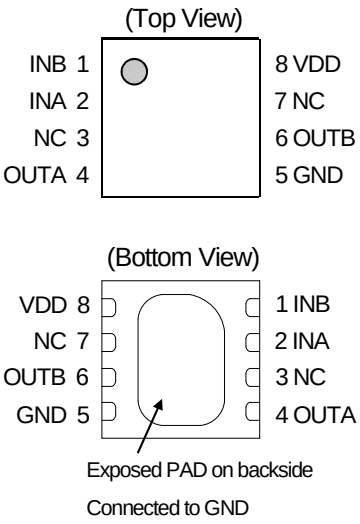
for driving DC Motors, Piezo Motors, Latching Solenoids and Latching relays.

■BLOCK DIAGRAM



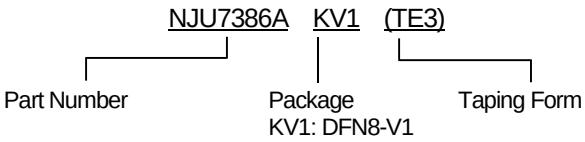
■PIN CONFIGURATION

DFN8-V1



PIN NO.	SYMBOL	I/O	DESCRIPTION
1	INB	I	Logic Input B
2	INA	I	Logic Input A
3	NC	-	Not Internally Connected
4	OUTA	O	Output A
5	GND	-	Ground
6	OUTB	O	Output B
7	NC	-	Not Internally Connected
8	VDD	-	Power Supply

■PRODUCT NAME INFORMATION



■ORDERING INFORMATION

PRODUCT NAME	PACKAGE OUTLINE	RoHS	HALOGEN-FREE	TERMINAL FINISH	MARKING	WEIGHT (mg)	MOQ(pcs)
NJU7386AKV1(TE3)	DFN8-V1	yes	yes	Sn2Bi	7386A	7.15	3000

■ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	RATINGS		UNIT
Supply Voltage	V_{DD}	7		V
Logic Input Voltage	V_{IN}	7		V
Output Current	I_{OPEAK}	Internal Limited		mA
Power Dissipation (Ta=25°C)	P_D	DFN8-V1	600(1)	mW
			1800(2)	
Junction Temperature	Tj	-40 to +150		°C
Storage Temperature	T_{stg}	-50 to +150		°C

(1): Mounted on glass epoxy board. (101.5×114.5×1.6mm: based on EIA/JEDEC standard, 2Layers FR-4, with Exposed Pad)

(2): Mounted on glass epoxy board. (101.5×114.5×1.6mm: based on EIA/JEDEC standard, 4Layers FR-4, with Exposed Pad)

(For 4Layers: Applying 99.5×99.5mm inner Cu area and thermal via holes to a board based on JEDEC standard JESD51-5)

■RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V_{DD}	1.8 to 5.5	V
Operating Temperature	T_{opr}	-40 to +125	°C

■**ELECTRICAL CHARACTERISTICS** (Unless otherwise noted, V_{DD}=3V, Ta=25°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
GENERAL						
Quiescent Current 1	I_{DD1}	Except I_{IH}, V_{IN}=3V	-	60	100	µA
Quiescent Current 2	I_{DD2}	Except I_{IH}, V_{DD}=5V, V_{INA}=1.8V, V_{INB}=0V	-	160	250	µA
Quiescent Current at Stand-by	I_{STB}		-	-	100	nA
UNDER VOLTAGE LOCKOUT BLOCK						
UVLO Operating Voltage	V_{DUVLO}		1.1	1.4	-	V
UVLO Recovery Voltage	V_{RUVLO}		-	1.5	1.8	V
UVLO Hysteresis Voltage	ΔV_{UVLO}		-	0.1	-	V
THERMAL SHUTDOWN BLOCK						
Thermal Shutdown Operating Temperature	T_{TSD1}		-	170	-	ºC
Thermal Shutdown Recovery Temperature	T_{TSD2}		-	150	-	ºC
Thermal Shutdown Hysteresis	ΔT_{TSD}		-	20	-	ºC
LOGIC BLOCK						
H Level Input Voltage 1	V_{IH1}	V_{DD}=5V	1.4	-	-	V
H Level Input Voltage 2	V_{IH2}		1.3	-	-	V
H Level Input Voltage 3	V_{IH3}	V_{DD}=1.8V	1.2	-	-	V
L Level Input Voltage 1	V_{IL1}	V_{DD}=5V	0	-	0.6	V
L Level Input Voltage 2	V_{IL2}		0	-	0.5	V
L Level Input Voltage 3	V_{IL3}	V_{DD}=1.8V	0	-	0.4	V
Input Hysteresis Width	ΔV_{IHYS}		-	0.1	-	V
H Level Input Current	I_{IH}	Per 1 Input	20	30	50	µA
L Level Input Current	I_{IL}	Per 1 Input	-	-	50	nA
Input Pull Down Resistance	R_{IN}		60	100	150	kΩ
Input Pulse Width	tp		0.5	-	-	µs
DRIVER BLOCK						
Output ON Resistance 1	R_{ON1}	V_{DD}=5V, I_O=400mA, H+L Sides	-	0.18	0.23	Ω
Output ON Resistance 2	R_{ON2}	I_O=400mA, H+L Sides	-	0.22	0.27	Ω
Output ON Resistance 3	R_{ON3}	V_{DD}=1.8V, I_O=400mA, H+L Sides	-	0.30	0.37	Ω
R_{ONH} Temperature Coefficient	$\Delta R_{ONH}/\Delta Tj$	Tj=-40 to 150ºC, I_O=400mA	-	0.33	-	mΩ/ºC
R_{ONL} Temperature Coefficient	$\Delta R_{ONL}/\Delta Tj$	Tj=-40 to 150ºC, I_O=400mA	-	0.33	-	mΩ/ºC
High Side Reverse Voltage	V_{ORH}	I_O=-400mA	-	0.7	0.9	V
Low Side Reverse Voltage	V_{ORL}	I_O=-400mA	-	0.7	0.9	V
High Side Leak Current	I_{OLEAKH}	V_{DD}=5.5V	-	-	200	nA
Low Side Leak Current	I_{OLEAKL}	V_{DD}=5.5V	-	-	200	nA
Output Turn ON Time	t_{ON}		50	115	180	ns
Output Turn OFF Time	t_{OFF}		5	25	45	ns
Dead Time	td		45	90	135	ns
OCP Detection Current 1	I_{OCP1}	V_{DD}=5V	1.7	3.3	-	A
OCP Detection Current 2	I_{OCP2}		1.5	2.8	-	A
OCP Detection Current 3	I_{OCP3}	V_{DD}=1.8V	1.2	2.2	3.2	A
OCP Recovery Time	t_{REOCP}		-	1	-	ms
Blanking Time	t_B		-	500	-	ns

■THERMAL CHARACTERISTICS

PARAMETER	SYMBOL	VALUE	UNIT
Junction-to-ambient thermal resistance	θja	208(3) 68(4)	°C/W
Junction-to-Top of package characterization parameter	ψjt	15(3) 7(4)	°C/W

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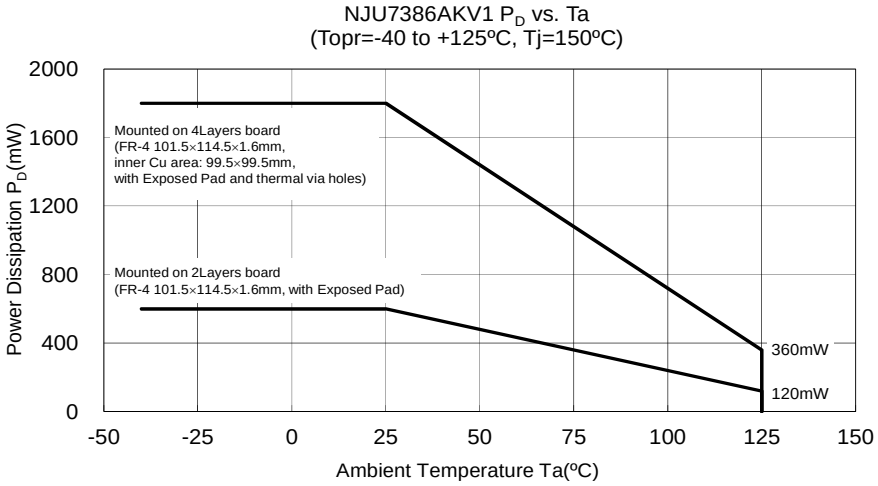
(2): Mounted on glass epoxy board. (101.5×114.5×1.6mm: based on EIA/JEDEC standard, 4Layers FR-4, with Exposed Pad)

(For 4Layers: Applying 99.5×99.5mm inner Cu area and thermal via holes to a board based on JEDEC standard JESD51-5)

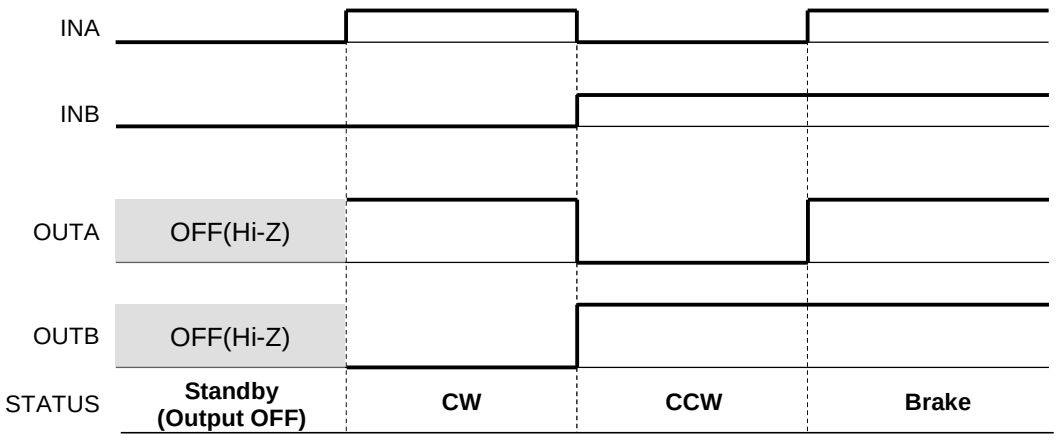
■POWER DISSIPATION vs. AMBIENT TEMPERATURE



■INPUT - OUTPUT TRUTH TABLE

INPUT (L=Low /Open, H=High, X=Don't care)		OUTPUT (H=Source, L=Sink, OFF=Hi-Z)		STATUS
INA	INB	OUTA	OUTB	
L	L	OFF		Standby(Fast Decay)
H	L	H	L	CW
L	H	L	H	CCW
H	H	H	H	Brake(Slow Decay)
X		OFF		UVLO, OCP, TSD

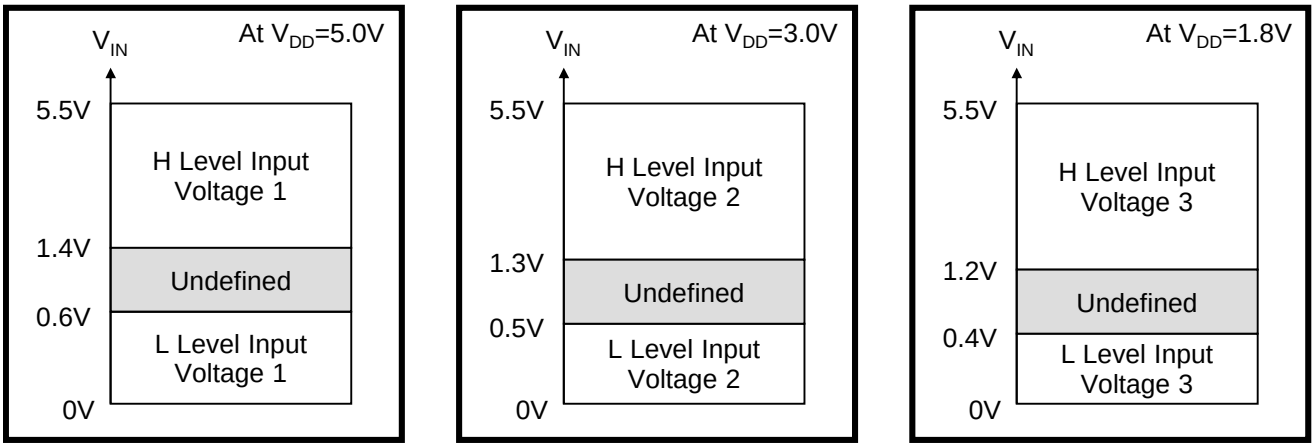
■INPUT - OUTPUT TIMING CHART



■APPLICATION NOTE / GLOSSARY

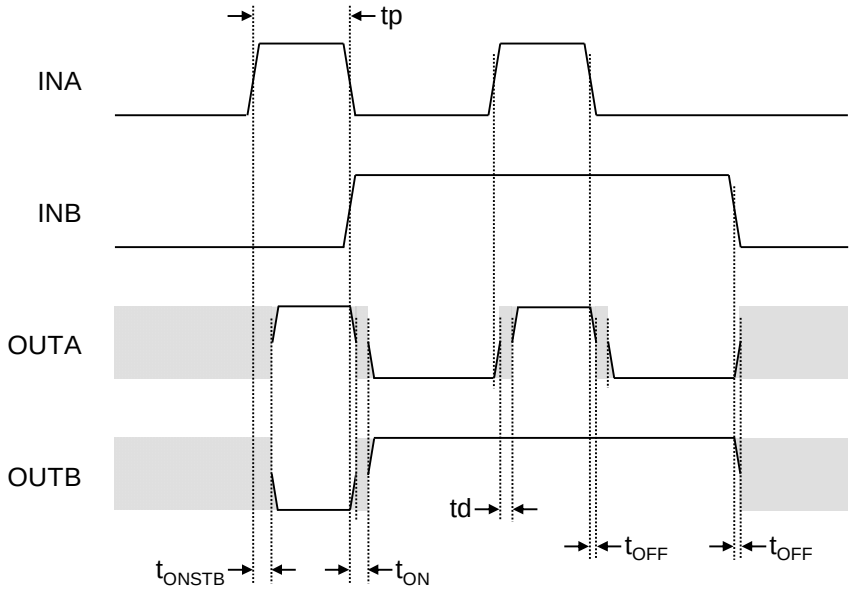
•Pin, Circuit Operation Definition

<INA, INB pin>



The H / L level threshold voltage slightly varies depending on the power supply pin voltage V_{DD}.
Further, The INA and INB pins correspond to input tolerant.

<Input - Output Timing Definition>



PARAMETER	SYMBOL
Input Pulse Width (Minimum Input Pulse Width)	tp

Output Turn ON Time at Standby	t_{ONSTB}
Output Turn ON Time	t_{ON}
Output Turn OFF Time	t_{OFF}
Dead Time (t_{ON}-t_{OFF})	td

Hi-Z

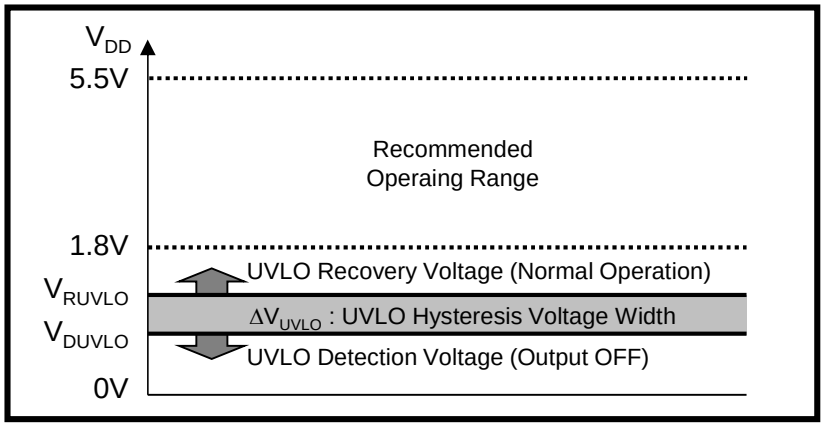
<Standby Function>

When the time of INA=L and INB=L exceeds approximately 4μs typ., it becomes the standby state and all protection functions are reset.

Further, the turn on time from the standby state is defined as t_{ONSTB}.

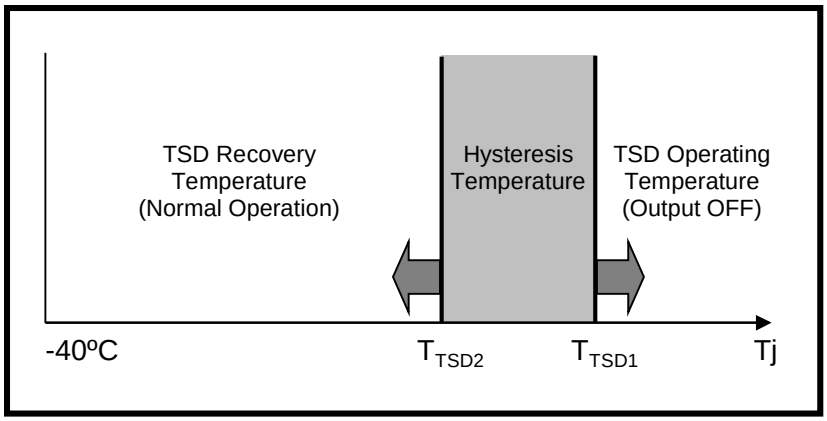
PARAMETER	SYMBOL	TYPICAL VALUE			UNIT
		V_{DD}=5.0V	V_{DD}=3.0V	V_{DD}=1.8V	
Output Turn ON Time at Standby	t_{ONSTB}	70	120	360	ns

<Under Voltage Lockout (UVLO) Operating Voltage>



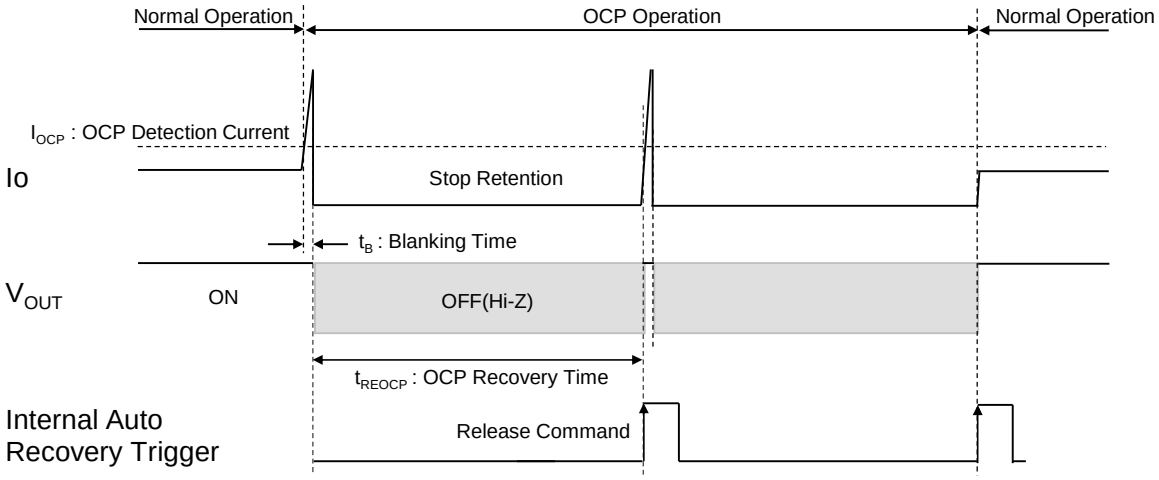
When the power supply pin voltage V_{DD} is less than the UVLO detection voltage, the output pins are turned off.
When the power supply pin voltage V_{DD} is over than the UVLO recovery voltage, it becomes to normal operation.

<Thermal Shutdown (TSD) Operating Temperature>



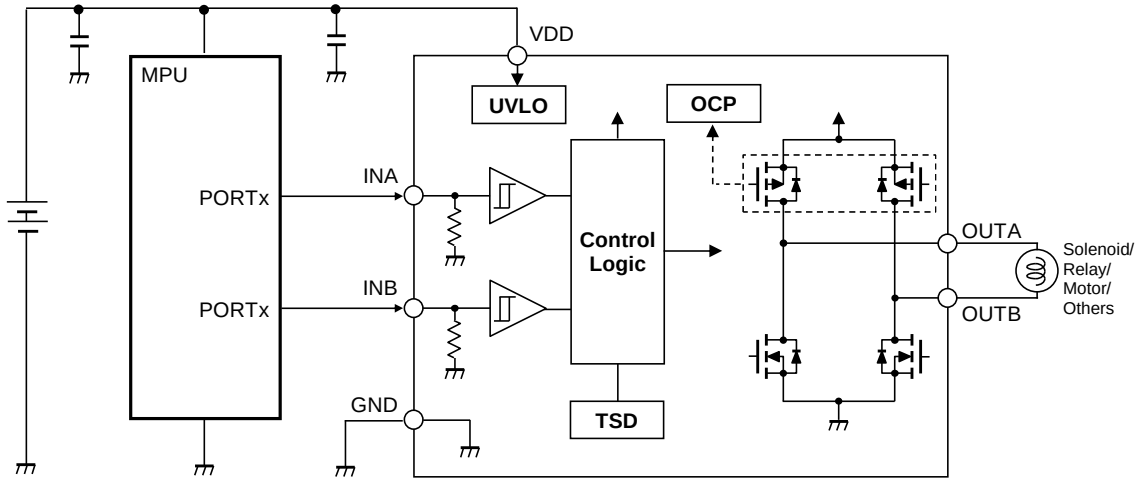
When the junction temperature Tj is over than T_{TSD1}, the thermal shutdown circuit operates and the output pins are turned off.
When the junction temperature Tj is less than T_{TSD2}, normal operation resumes.

<Over Current Protection (OCP) Timing Chart>



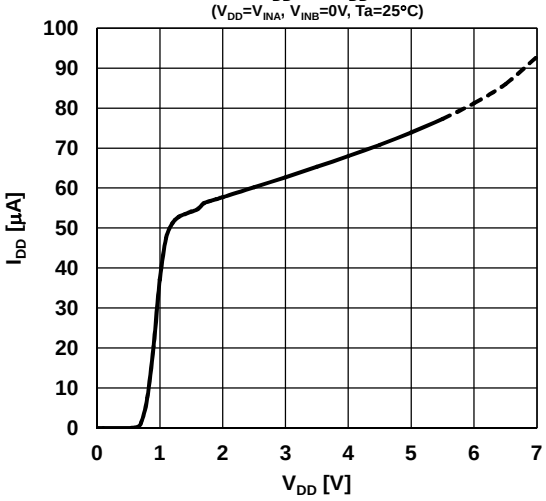
The OCP function detects the overcurrent of the output pins.
If the output current exceeding I_{OCP} flows to continue more than t_B time, the OCP operates and the output pins are turned off.
In the OCP state, the output pins automatically resume after the OCP recovery time t_{REOCP}.

•Typical Application

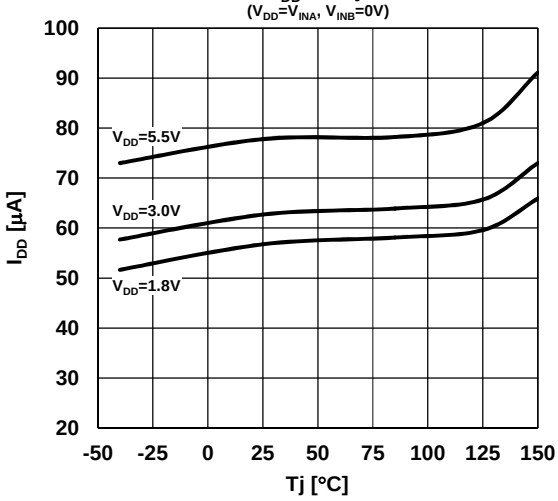


■TYPICAL CHARACTERISTICS

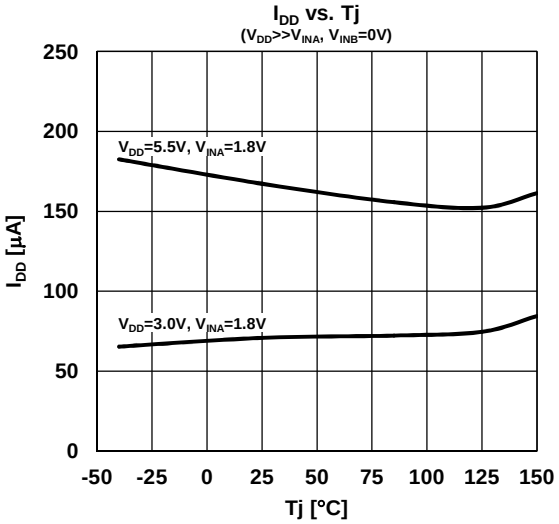
I_{DD} vs. V_{DD}
(V_{DD}=V_{INA}, V_{INB}=0V, Ta=25°C)



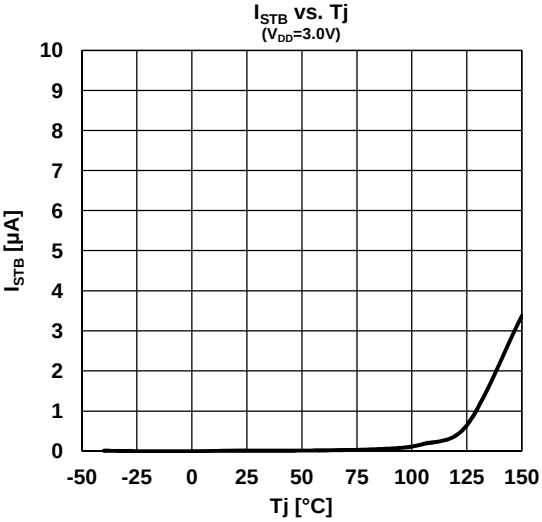
I_{DD} vs. Tj
(V_{DD}=V_{INA}, V_{INB}=0V)



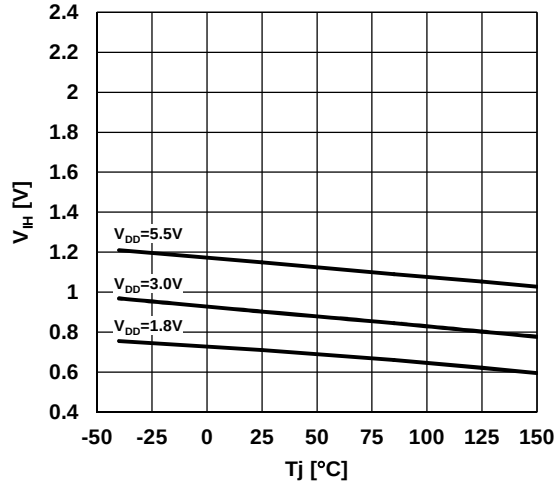
I_{DD} vs. Tj
(V_{DD}>>V_{INA}, V_{INB}=0V)



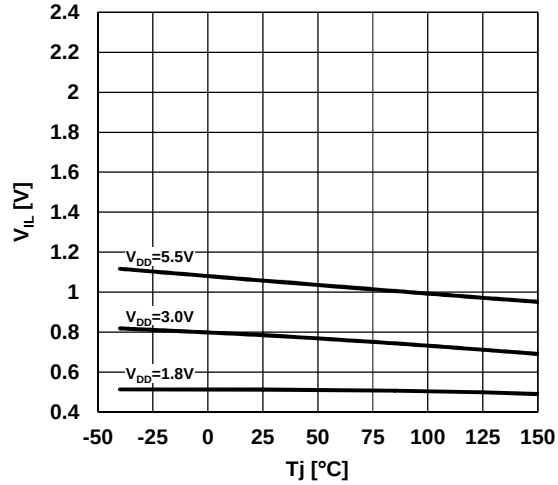
I_{STB} vs. Tj
(V_{DD}=3.0V)



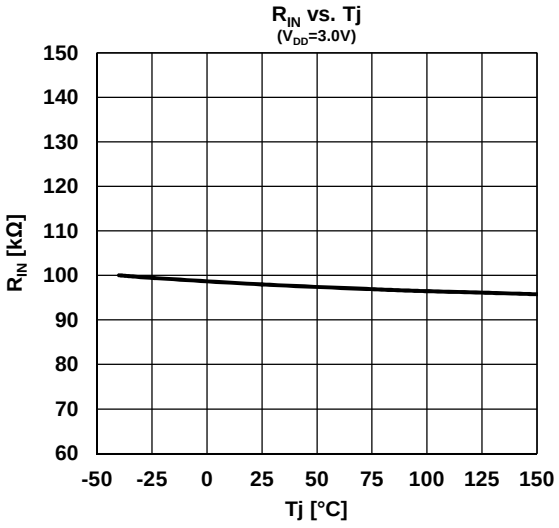
V_{IH} vs. Tj

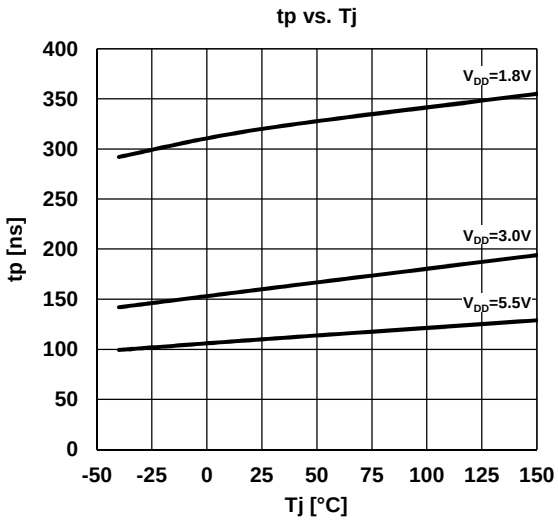


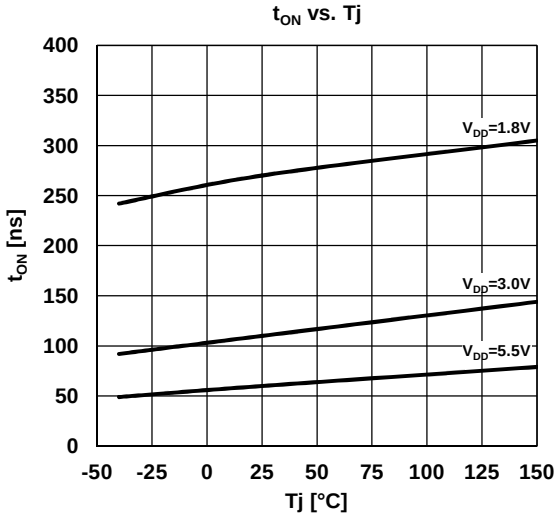
V_{IL} vs. Tj

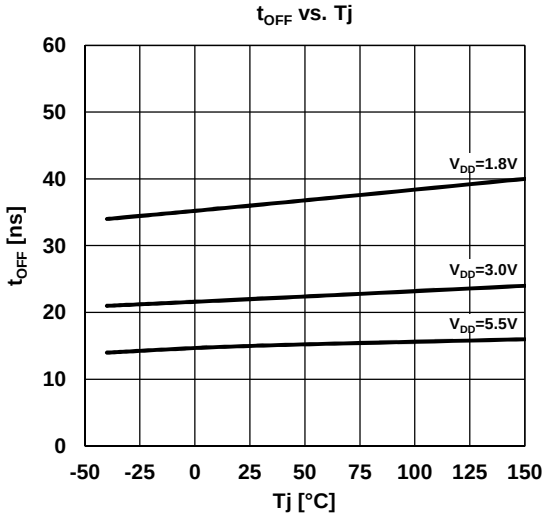


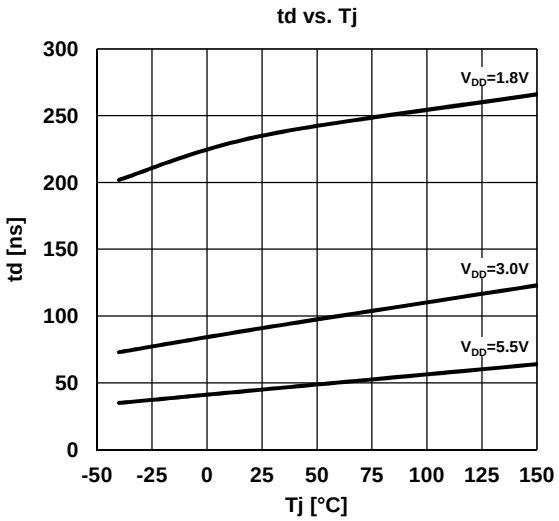
■TYPICAL CHARACTERISTICS

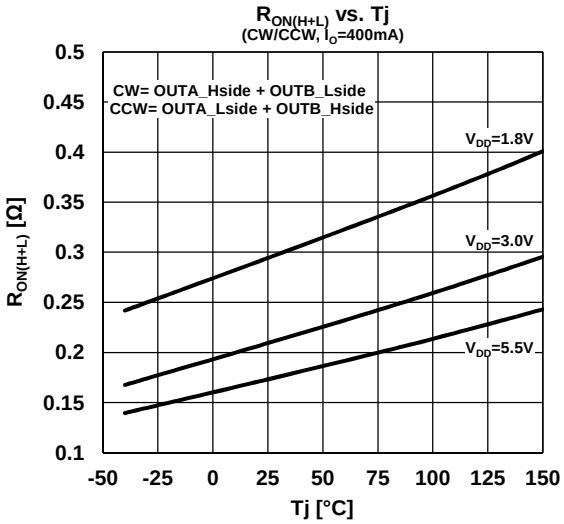






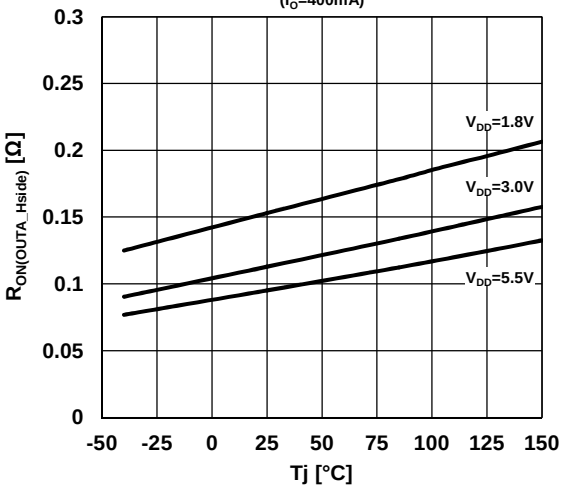




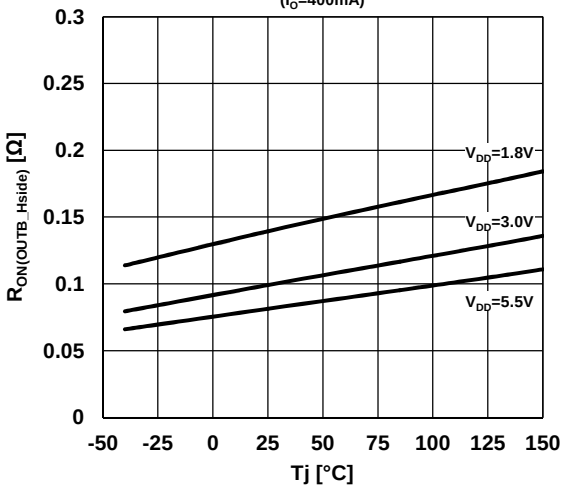


■TYPICAL CHARACTERISTICS

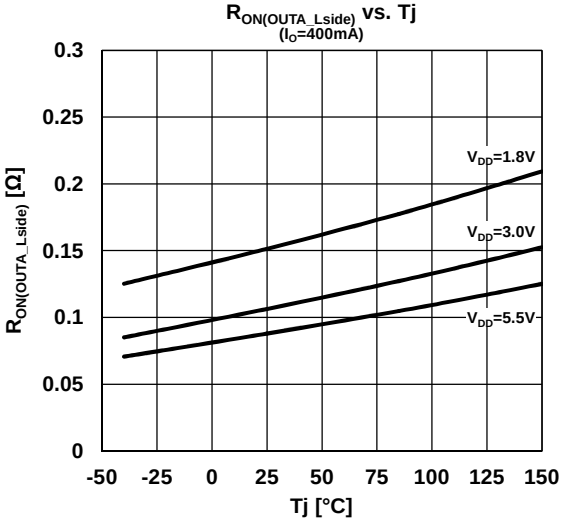
$R_{ON(OUTA\_Hside)}$ vs. Tj
(I_O=400mA)



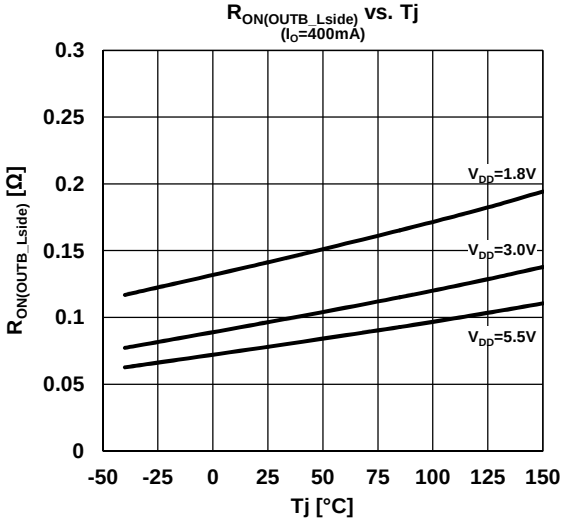
$R_{ON(OUTB\_Hside)}$ vs. Tj
(I_O=400mA)



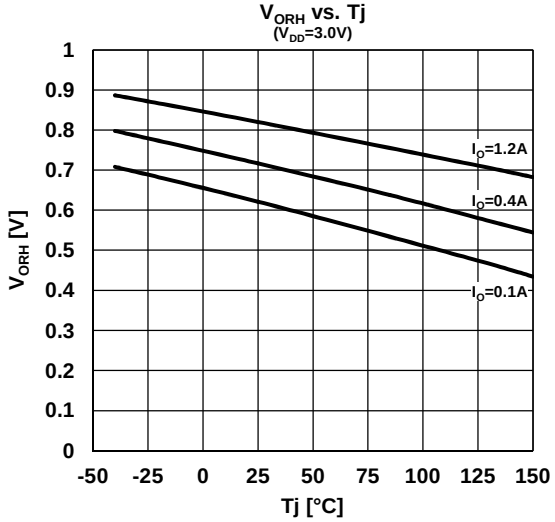
$R_{ON(OUTA\_Lside)}$ vs. Tj
(I_O=400mA)



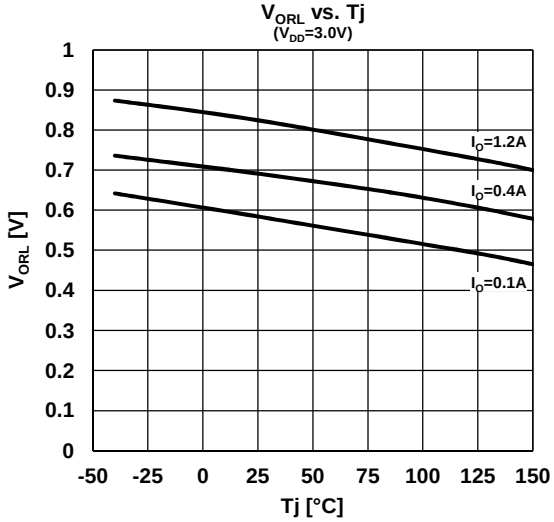
$R_{ON(OUTB\_Lside)}$ vs. Tj
(I_O=400mA)



V_{ORH} vs. Tj
(V_{DD}=3.0V)

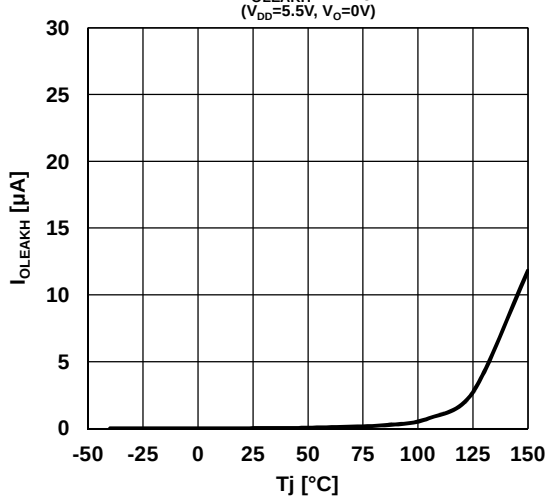


V_{ORL} vs. Tj
(V_{DD}=3.0V)

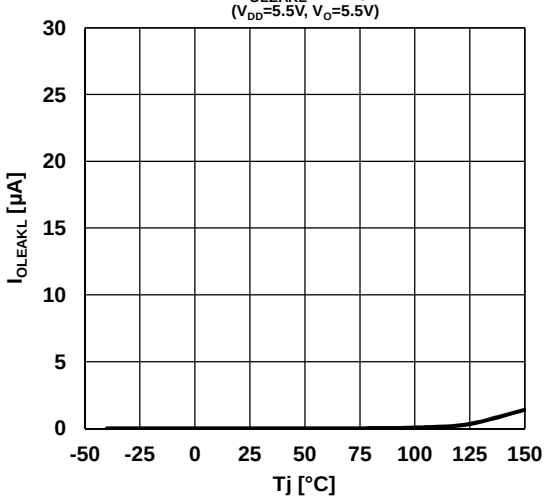


■TYPICAL CHARACTERISTICS

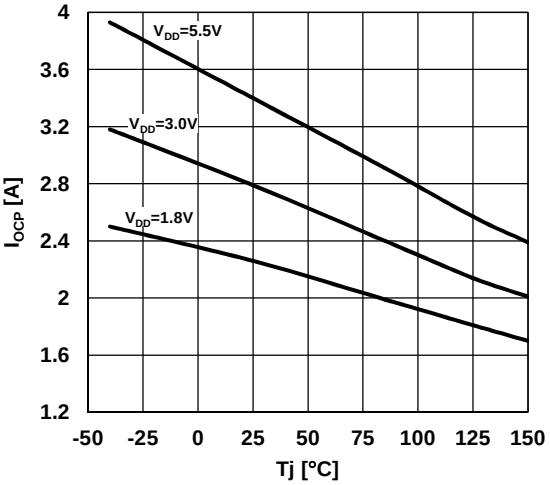
I_{OLEAKH} vs. Tj
(V_{DD}=5.5V, V_O=0V)



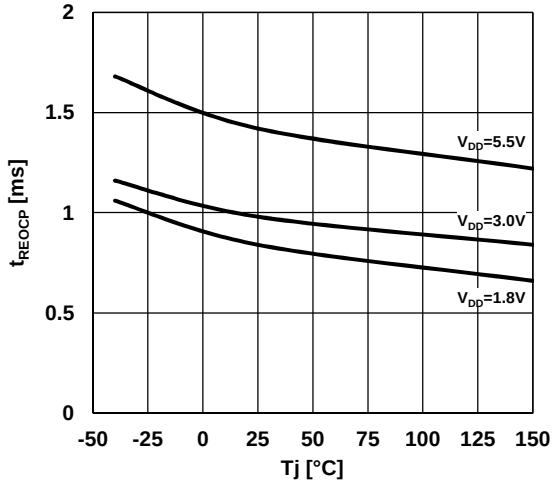
I_{OLEAKL} vs. Tj
(V_{DD}=5.5V, V_O=5.5V)



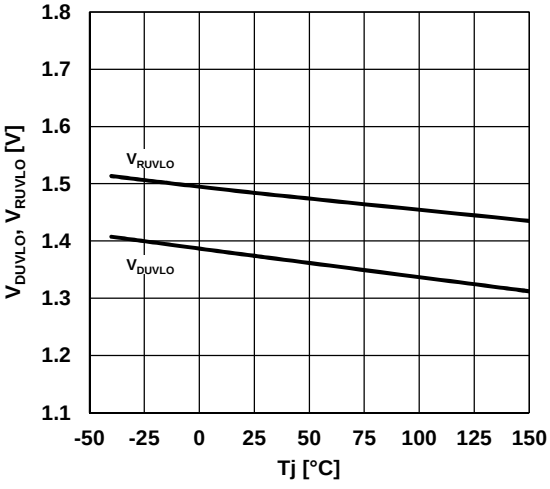
I_{OCP} vs. Tj



t_{REOCP} vs. Tj



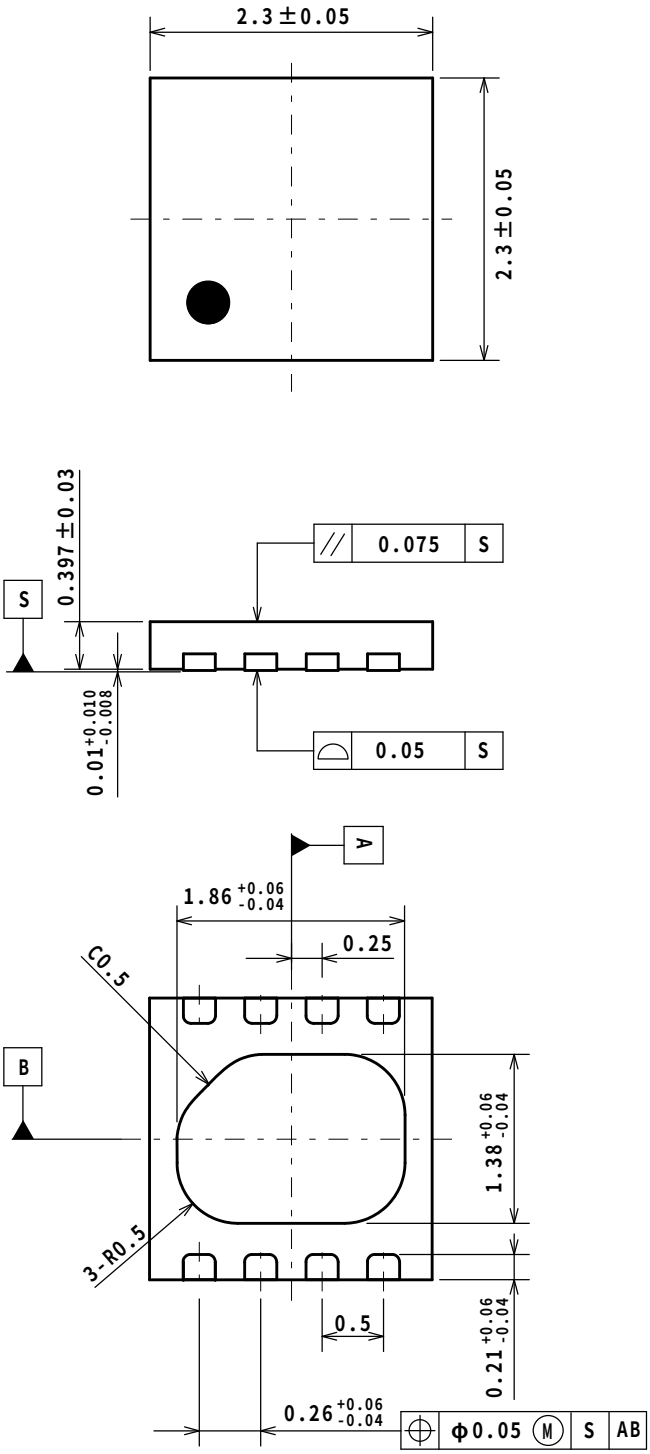
V_{DUVLO}, V_{RUVLO} vs. Tj



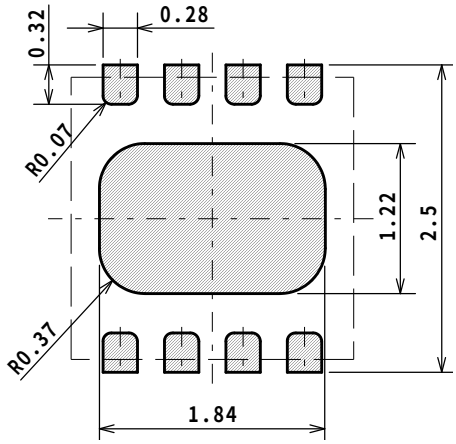
DFN8-V1

Unit: mm

■PACKAGE DIMENSIONS



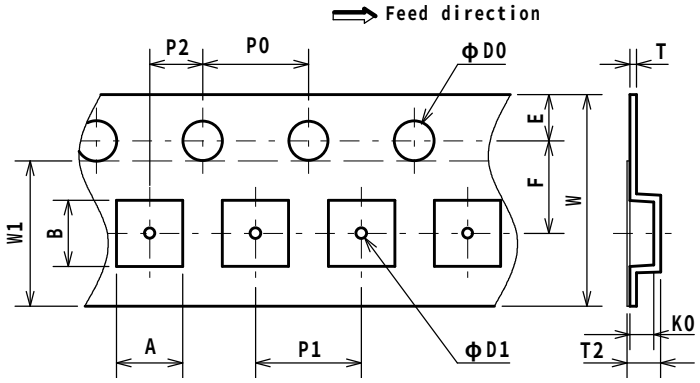
■EXAMPLE OF SOLDER PADS DIMENSIONS



■PACKING SPEC

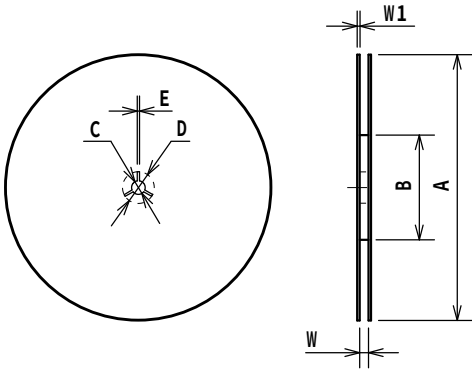
Unit: mm

TAPING DIMENSIONS



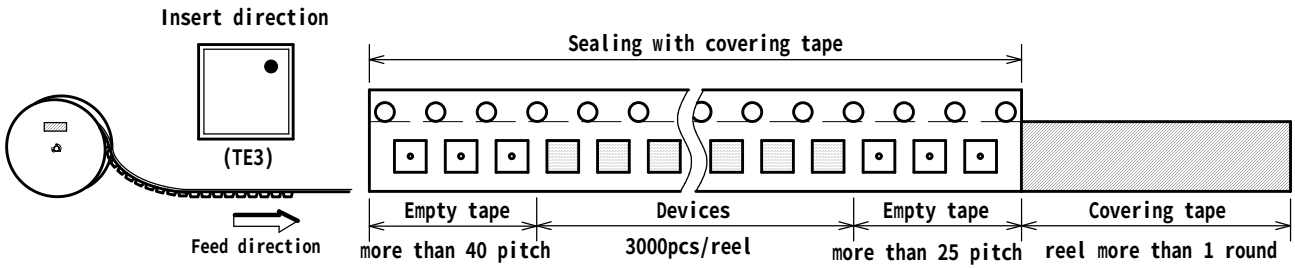
SYMBOL	DIMENSION	REMARKS
A	2.55±0.05	BOTTOM DIMENSION
B	2.55±0.05	BOTTOM DIMENSION
D0	$1.5^{+0.1}_{0}$	
D1	0.5±0.1	
E	1.75±0.1	
F	3.5±0.05	
P0	4.0±0.1	
P1	4.0±0.1	
P2	2.0±0.05	
T	0.25±0.05	
T2	1.00±0.07	
K0	0.65±0.05	
W	8.0±0.2	
W1	5.5	THICKNESS 0.1max

REEL DIMENSIONS

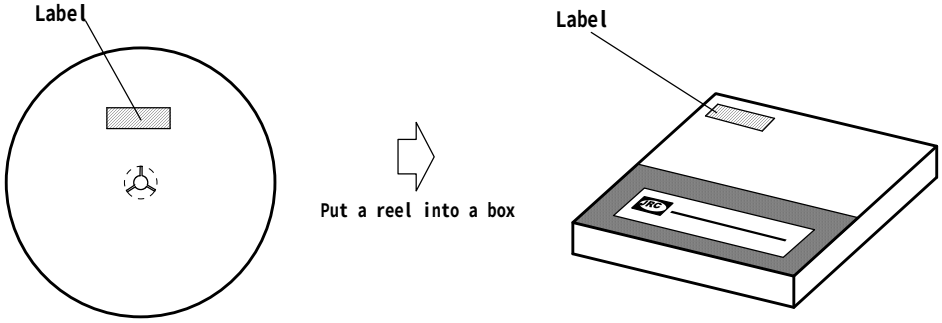


SYMBOL	DIMENSION
A	$\Phi 180^{0}_{-1.5}$
B	$\Phi 60^{+1}_{0}$
C	Φ 13±0.2
D	Φ 21±0.8
E	2±0.5
W	$9^{+0.3}_{0}$
W1	1.2

TAPING STATE



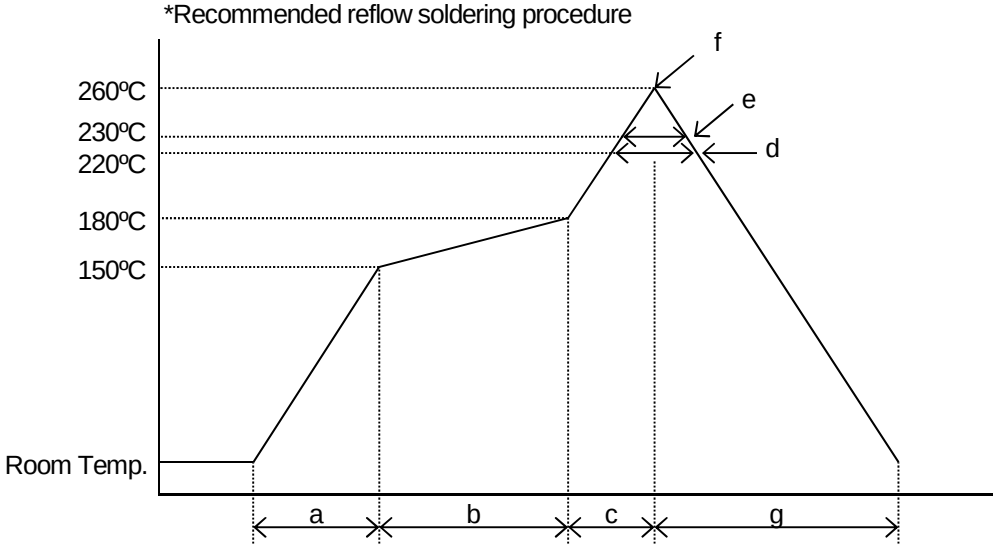
PACKING STATE



■RECOMMENDED MOUNTING METHOD

INFRARED REFLOW SOLDERING METHOD

*Recommended reflow soldering procedure



a:	Temperature ramping rate	: 1 to 4ºC/s
b:	Pre-heating temperature	: 150 to 180ºC
	Pre-heating time	: 60 to 120s
c:	Temperature ramp rate	: 1 to 4ºC /s
d:	220ºC or higher time	: Shorter than 60s
e:	230ºC or higher time	: Shorter than 40s
f:	Peak temperature	: Lower than 260ºC
g:	Temperature ramping rate	: 1 to 6ºC /s

The temperature indicates at the surface of mold package.

■REVISION HISTORY

Date	Revision	Changes
11.Mar.2020	Ver.1.0	New Release

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   - Power Generator Control Equipment (Nuclear, steam, hydraulic, etc.)
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   - Various Safety Devices

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