FUJITSU SEMICONDUCTOR
DATA SHEET

DS04-27601-3E

ASSP For Power Supply Applications

Power Management Switch

MB3802

■ DESCRIPTION

The MB3802 is a power management switch incorporating two switch circuits with extremely low ON resistance.

NO diode is required because the switch block is configured with an N-ch MOS to prevent reverse current at switch OFF.

The MB3802 starts at a very low voltage (typical V_{IN} > 2.2V) and a stable ON resistance is obtained irrespective of the switching voltage because the internal DC/DC converter applies the optimum voltage for the N-ch MOS gate at switch ON.

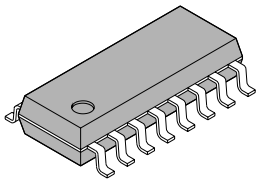
Moreover, the load-side capacitor is discharged at switch OFF, and the power supply for various power supply systems is switched efficiently.

■ FEATURES

- Extremely low ON resistance:
  R_{ON} = 0.12 Ω (typical)
  R_{ON} = 0.06 Ω (typical at parallel connection)
- Reverse current protection at load side at switch OFF
- Operation start at low input voltage: V_{IN} > 2.2 V (typical)
- Low power consumption
  At switch OFF: I_{IN} (input voltage) = 0 μA, V_{IN} = 0 V
  At switch ON: I_{IN} = 230 μA, V_{IN} = 5 V
- Load discharge function
- External control of ON/OFF time
- Break-before-make operation

■ PACKAGE

16-pin plastic SOP



(FPT-16P-M04)

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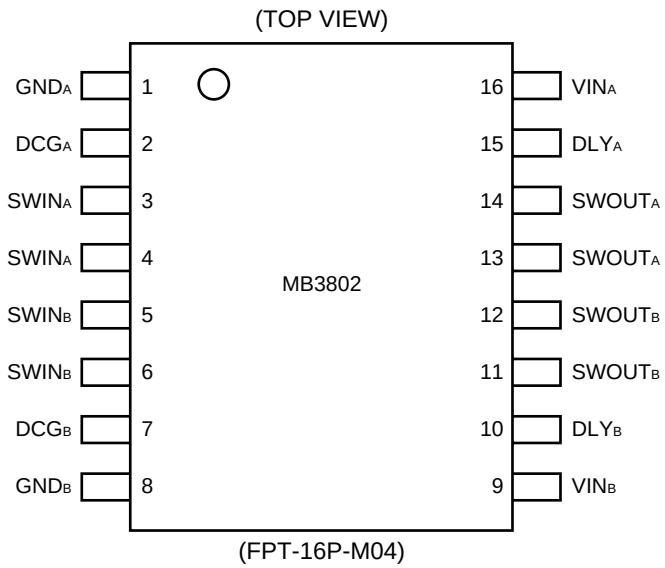
■ PIN ASSIGNMENT



■ PIN DESCRIPTION (SCSI Interface)

Pin No.	Pin symbol	Description
16	V_{IN_A}	These pins switch ON at High level and OFF at Low level. They serve as power-supply pins for the DC/DC converter to generate the switch gate voltage.
9	V_{IN_B}	
3, 4	$SWIN_A$	**Switch Input pins:** Two common pins are assigned to $SWIN_A$ and $SWIN_B$. They serve as power-supply pins for the switch-OFF circuit which starts at 1.5 V Min.
5, 6	$SWIN_B$	
13, 14	$SWOUT_A$	**Switch output pins:** Two common pins are assigned to $SWOUT_A$ and $SWOUT_B$. When DCGA and DCGB are High level, the load-discharge circuit starts discharge via these pins.
11, 12	$SWOUT_B$	
2	DCG_A	**$SWOUT_A$/$SWOUT_B$-side discharge control pins:** These pins are used to discharge from the load-side capacitor at switch OFF. Connect them to GND when discharge is not required.
7	DCG_B	
15	DLY_A	**Switch-ON/OFF control pins:** The ON/OFF time can be delayed by connecting an external capacitor. Both times are delayed about three fold by installing a 500-pF capacitor between these pins and GND. Leave these pins open when they are not used. 10 V may be generated when these pins are open. To keep these pins at high impedance, take care to mount the device so that no current leaks (less than 0.1 μA).
10	DLY_B	
1	GND_A	**Ground pins for input threshold reference voltage and load discharge:** When two switching circuits are used, ground both GND pins.
8	GND_B	

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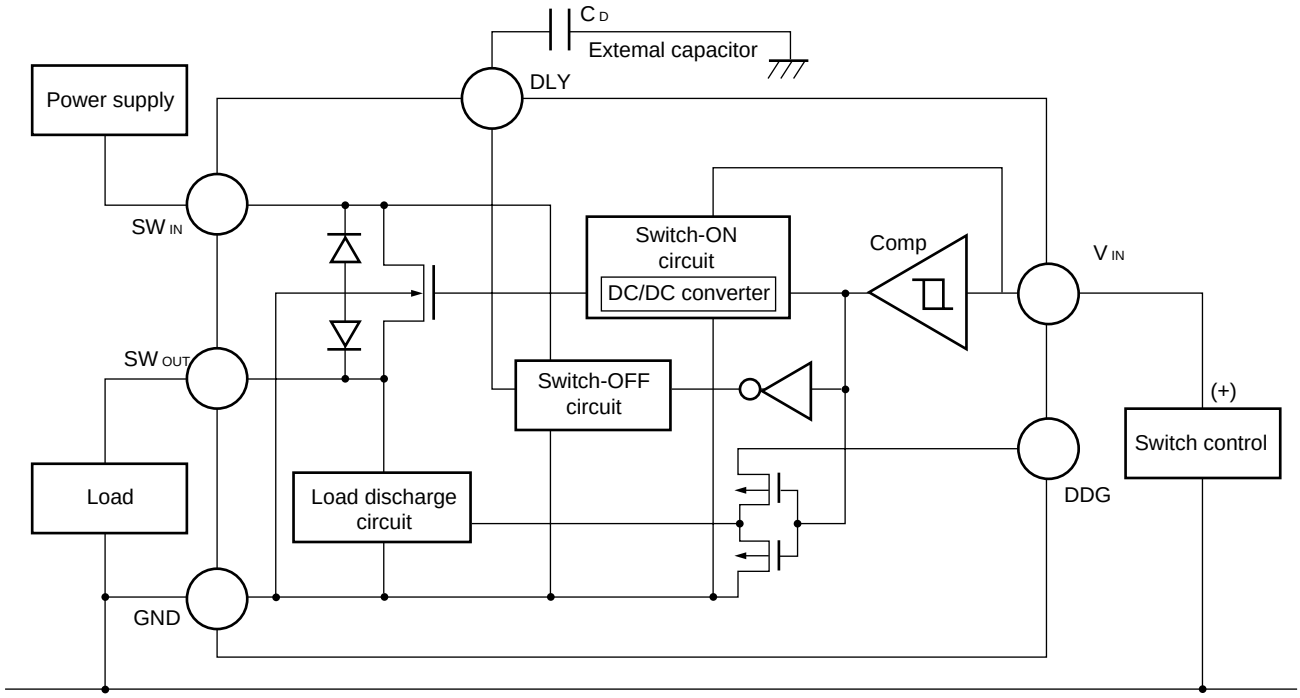
■ BLOCK DIAGRAM AND EXTERNAL CONNECTIONS



Note : The MB3802 incorporates two switch blocks as shown above. However, GND is common to both blocks.

■ BLOCK DESCRIPTION

The MB3802 is a one-way switching IC with the SWIN and SWOUT pins serving respectively for input and output. When V_{IN} exceeds 2.2 V, the Comp. starts driving the DC/DC converter to switch the N-ch MOS and applies the optimum voltage for the switch gate.

The DC/DC converter boosts the V_{IN} voltage.

When VIN is below 2.1 V, the Comp. stops the DC/DC converter, starts the switch-OFF circuit, and discharges the voltage from the switch gate to GND. The switch-OFF circuit is powered from the SW_{IN} and consumes 0.4 µA at 5 V.

Since the N-ch MOS back gate is connected to GND, switch-OFF reverse current is prevented irrespective of the High level state between SW_{IN} and SW_{OUT}. Note, however, that turning the VIN pin on/off with 1.5 V or less applied to the SWIN pin may cause reverse current to flow because the switch-off circuit does not work then. For the method of compensating for the operation of the switch-off circuit, see section "■APPLICATIONS 7.Low-side Switch."

The load discharge circuit installed between SW_{OUT} and GND is powered by the DCG pin, and discharges the load-side capacitor at switch OFF. When it is not necessary to discharge the load, connect the DCG pin to GND.

The DLY pins are for connection to an external capacitor to delay the switch-ON/OFF time. The surge current at the load side is cut at power-on by controlling the switch-ON time. The switch-ON time depends on the boot time of the DC/DC converter. Consequently, when the VIN level is high and the SW_{IN} level is low, the switch-ON time is small; when the SW_{IN} level is high, the switch-OFF time is small.

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■ ABSOLUTE MAXIMUM RATING

(Ta = +25°C)

Parameter	Symbol	Condition	Ratings		Unit
			Min	Max	
Input Voltage	V_{IN}	—	–0.3	7.0	V
Switching voltage	V_{SW}	At switch OFF	–0.3	7.0	V
		At switch ON	–0.3	7.0	
Switching current	I_{SW}	At switch-ON peak	—	3.6	A
Permissible loss	P_D	Ta ≤ + 75°C	—	290	mW
Storage Temperature	T_{STG}	—	–55	+125	°C

WARNING: Semiconductor devices can be permanently damaged by application of stress (voltage, current, temperature, etc.) in excess of absolute maximum ratings. Do not exceed these ratings.

■ RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Conditions	Value			Unit
			Min	Typ	Max	
Input voltage	V_{IN}	—	0	—	6.0	V
Switching level	V_{SWIN}	At switch ON	0	—	6.0	V
		At switch OFF	0	—	6.0	
Switching current	I_{SW}	At switch on (for single switch)	—	—	1.2	A
Gate-pin connection capacitance	C_D	—	—	—	10	nF
Gate-pin mounting leak current	I_{DLY}	—	–0.1	—	0.1	µA
Input voltage to load discharge circuit	V_{DCG}	V_{IN} = 3 V, 5 V	2.5	—	6.0	V
Operating temperature	T_{op}	—	–40	—	+7.5	°C

WARNING: The recommended operating conditions are required in order to ensure the normal operation of the semiconductor device. All of the device's electrical characteristics are warranted when the device is operated within these ranges.

Always use semiconductor devices within their recommended operating condition ranges. Operation outside these ranges may adversely affect reliability and could result in device failure.

No warranty is made with respect to uses, operating conditions, or combinations not represented on the data sheet. Users considering application outside the listed conditions are advised to contact their FUJITSU representatives beforehand.

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■ ELECTRICAL CHARACTERISTICS

1. DC Characteristics

(Ta = +25°C)

Parameter	Symbol	Condition	Value			Unit
			Min	Typ	Max	
Input current	I_{IN1}	V_{IN} = 0 V	—	0	—	µA
	I_{IN2}	V_{IN} = 3 V	—	100	200	µA
		V_{IN} = 5 V	—	230	460	µA
Swiching resistance	R_{ON1}	V_{IN} = 3 V, I_{SW} = 0.5 A, V_{SWIN} = 3 V	—	120	160	mΩ
	R_{ON2}	V_{IN} = 5 V, I_{SW} = 0.5 A, V_{SWIN} = 3 V	—	130	175	mΩ
Switch-OFF leak current	I_L	V_{IN} = 0 V, V_{SWIN} = 6 V	—	0.5	2.0	µA
Input threshold voltage	V_{TH1}	At switch ON	2.0	2.2	2.4	V
	V_{TH2}	At switch OFF	1.9	2.1	2.3	V
Input hysteresis width	V_{HYS}	—	50	100	—	mV
Switch resistance	R_{ON}	V_{IN} = 3 V, 5 V, I_{SW} = 0.5 A Ta = –40°C to +75°C	—	—	210	mΩ
Switch charge resistance	R_{DCG1}	V_{SWOUT} = 3 V, V_{DCG} = 3 V	—	750	1500	Ω
	R_{DCG2}	V_{SWOUT} = 5 V, V_{DCG} = 5 V	—	500	1000	Ω
Input voltage to switch charge circuit	I_{DCG}	V_{DCG} = 5 V	—	0	2	µA

2. AC Characteristics

(Ta = +25°C)

Parameter	Symbol	Condition	Value			Unit
			Min	Typ	Max	
Switch-ON time	t_{ON1}	V_{IN} = 0 V → 3 V, V_{SWIN} = 3 V	20	300	900	µs
	t_{ON2}	V_{IN} = 0 V → 5 V, V_{SWIN} = 5 V	20	150	450	µs
Switch OFF time	t_{OFF1}	V_{IN} = 3 V → 0 V, V_{SWIN} = 3 V	5	60	180	µs
	t_{OFF2}	V_{IN} = 5 V → 0 V, V_{SWIN} = 5 V	5	30	150	µs
Switch ON/OFF time lag	t_{HYS1}	V_{IN} = 3 V / 0 V, V_{SWIN} = 3 V	10	240	720	µs
	t_{HYS2}	V_{IN} = 5 V / 0 V, V_{SWIN} = 5 V	10	120	300	µs

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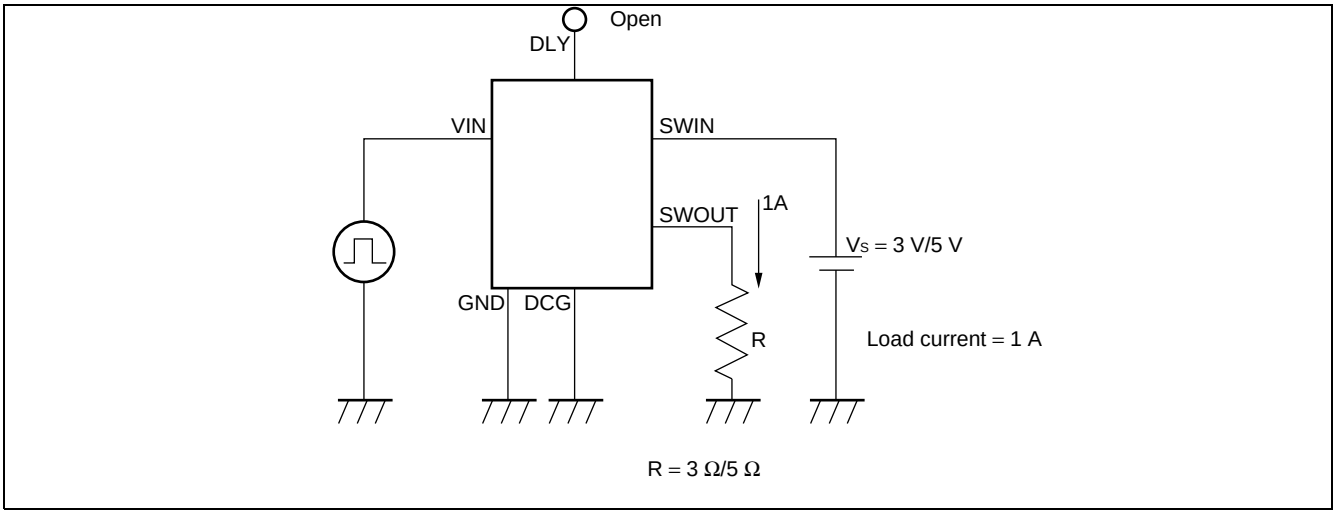
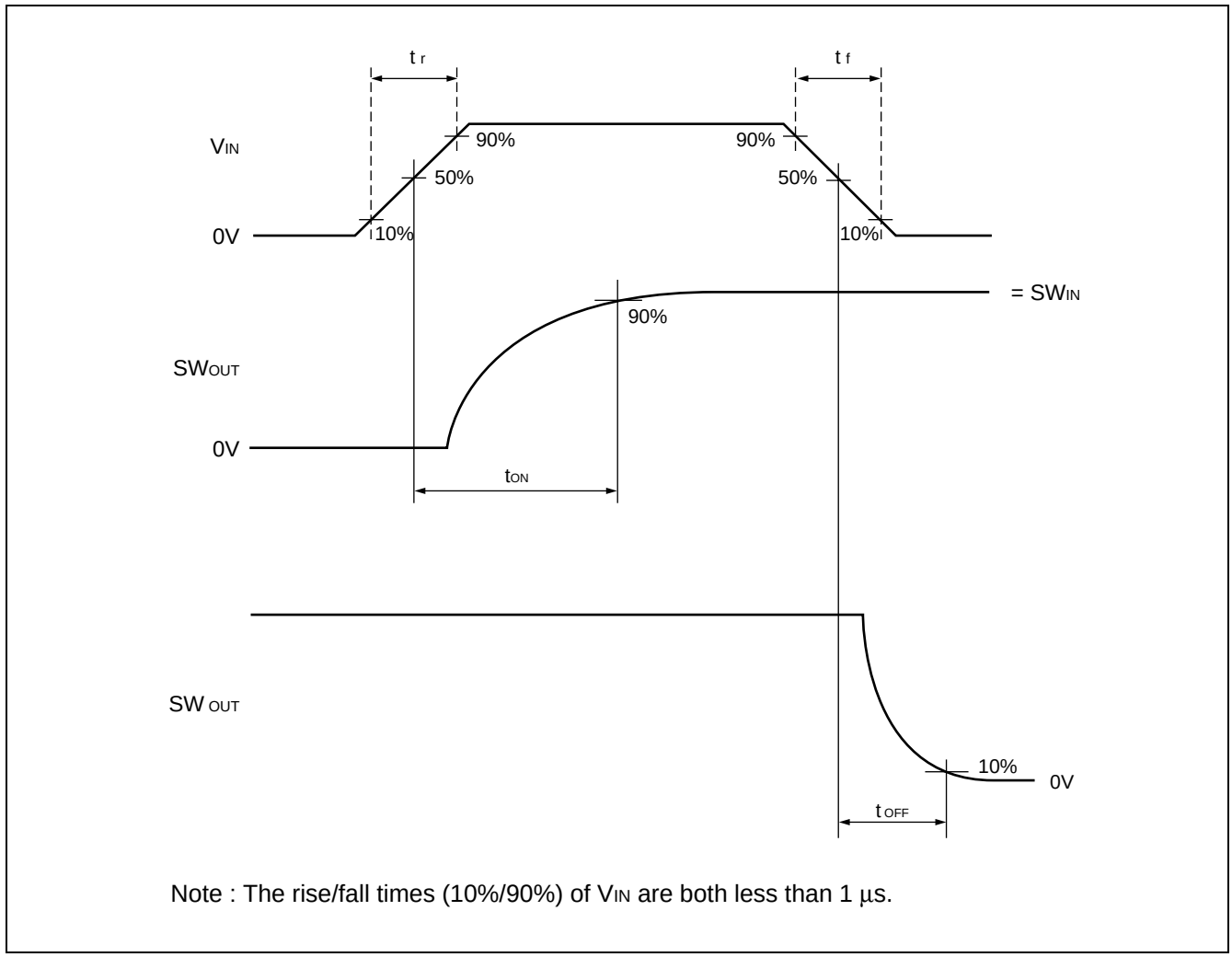
■ AC CHARACTERISTIC TEST DIAGRAMS

1. Test Condition



2. Switch-ON/OFF Timing Chart



Note : The rise/fall times (10%/90%) of V_{IN} are both less than 1 µs.

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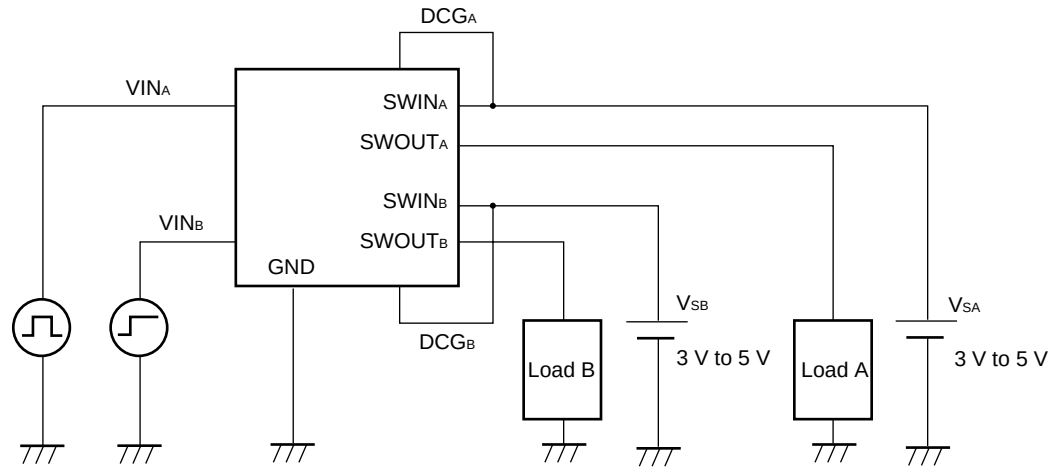
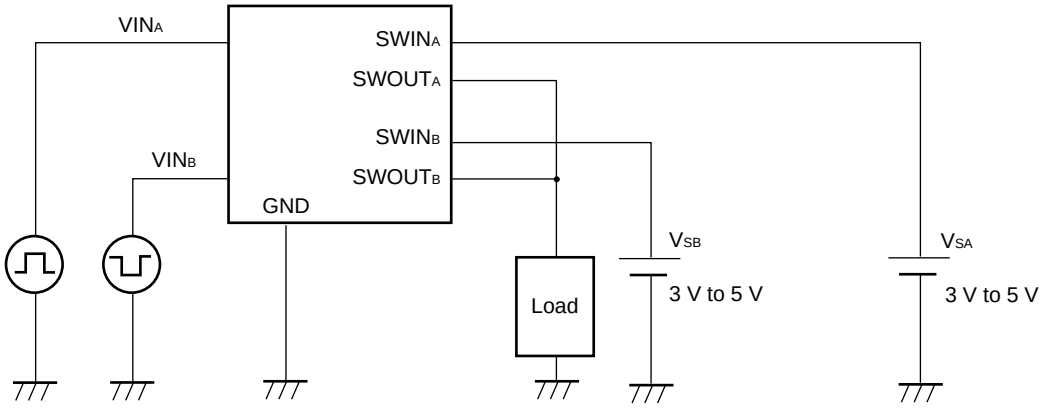
■ APPLICATIONS

1. Separate Use of Two Switching Circuits



Notes : • The two power supplies V_{SA} andV_{SB} can be used separated by controlling the voltages V_{INA} and V_{INB}.
• Connect the DCD pin to GND when it is not used.

2. Switching Two Power Supplies



Note : When using different power supplies for a single load, control them by connecting an external capacitor so that both switches are not ON at the same time.

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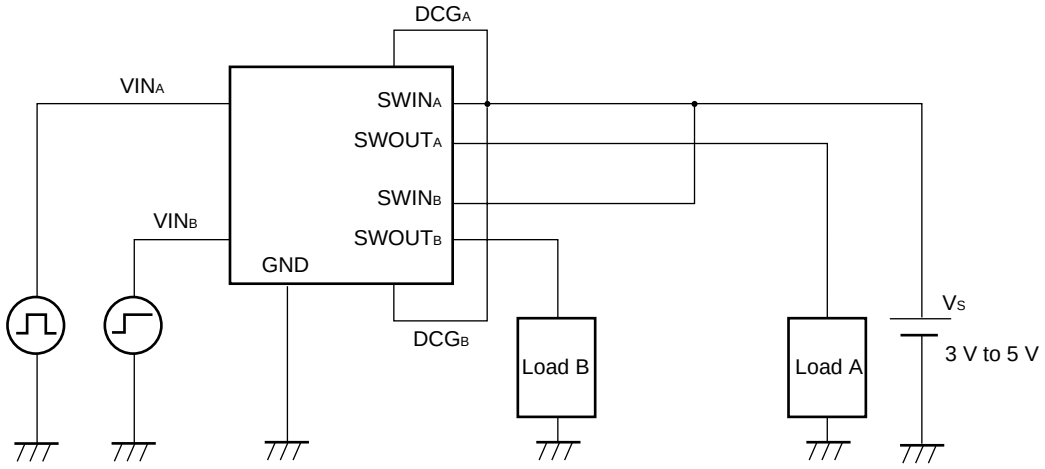
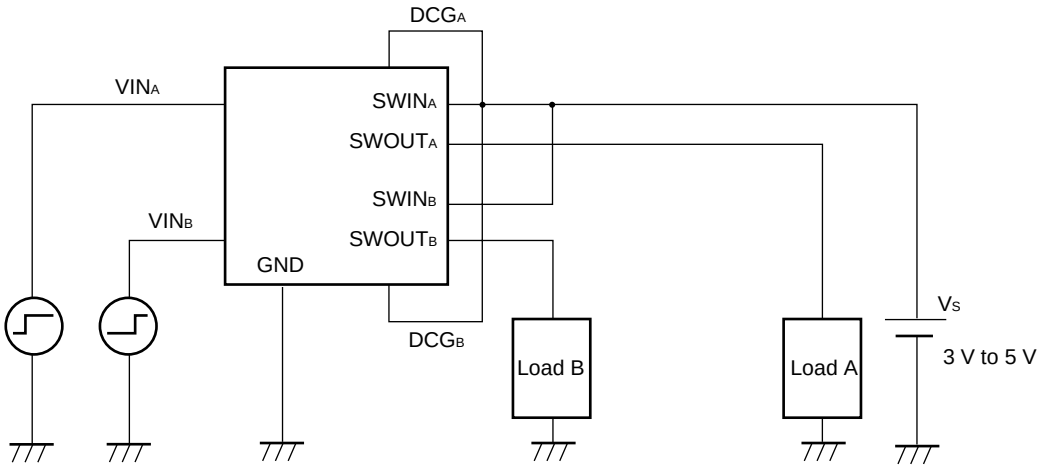
3. Switching Two Loads



Note : Make this connection to control two different loads separately for a single power supply.

4. Connecting Serial Switches



Note : Make this connection to supply power from V_S to load B via load A.

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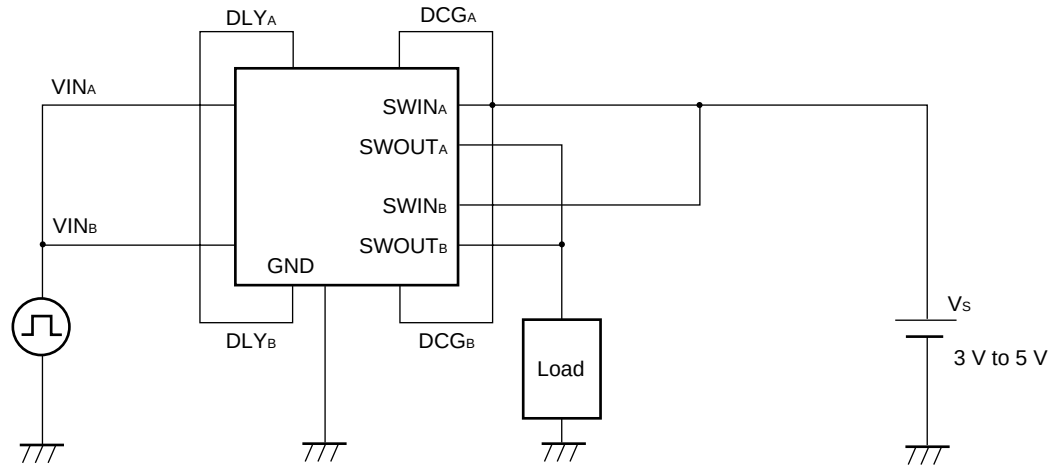
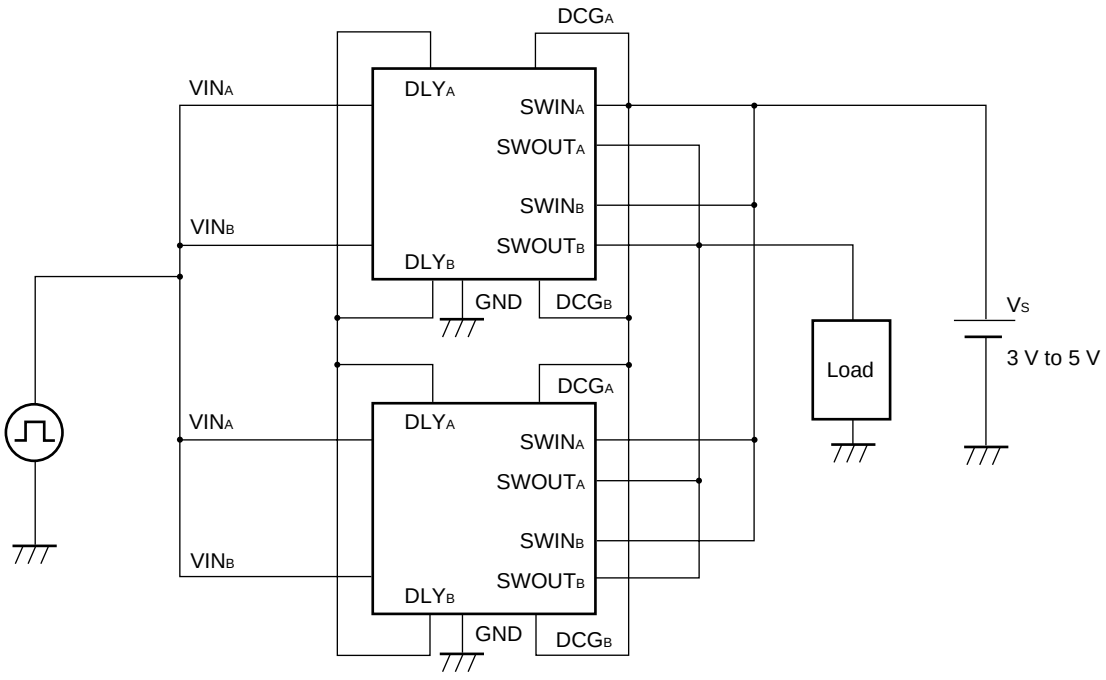
5. Connecting Parallel Switches



Note : Connect the circuits A and B in parallel to produce a low ON resistance (R_{ON} = 0.06 Ω). In this case, connect the DLYA and DLYB pins in common to give synchronous ON/OFF between both switches.

6. 25% ON Resistance



Notes : • Make this connection to produce an ON resistance that is much lower than the above connection. Also, connect the DLY pins in common.
• Consider the difference between the ON resistances and the switch-ON/OFF times between two devices (MB3802) and insure that load control is not offset at one device.

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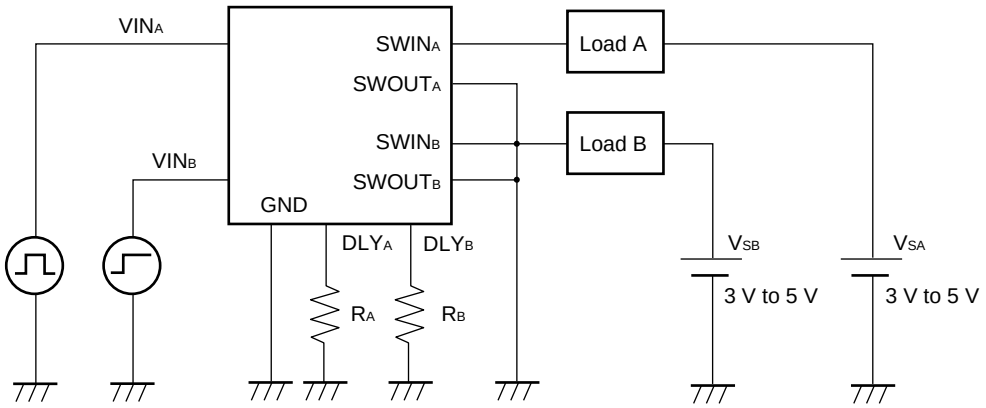
7. Low-side Switch



	V_{IN} = 3 V, V_S = 3 V	V_{IN} = 5 V, V_S = 5 V
Switch-ON time Switch-OFF time	80 µs 5.0 ms	45 µs 3.5 ms

R_A and R_B = 10 MΩ

Notes :
- Make this connection to control the switch ON/OFF at the lower load side.
- To assist the switch-OFF circuit operation driven by the SW_{IN} power supply, connect high resistances (R_A and R_B = 5 MΩ to 10 MΩ) to the DLY pins without overloading the DC/DC converter.
- At this connection, the switch-OFF time is longer than the switch-ON time.

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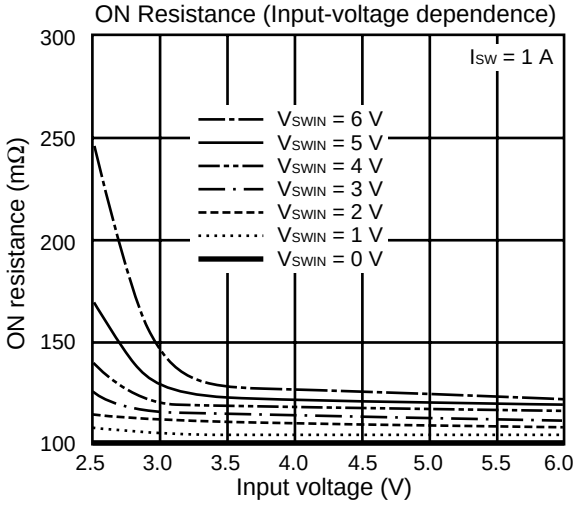
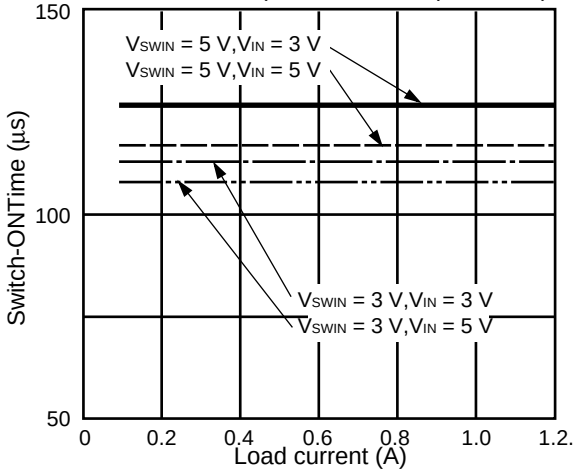
■ TYPICAL PERFORMANCE CHARACTERISTICS

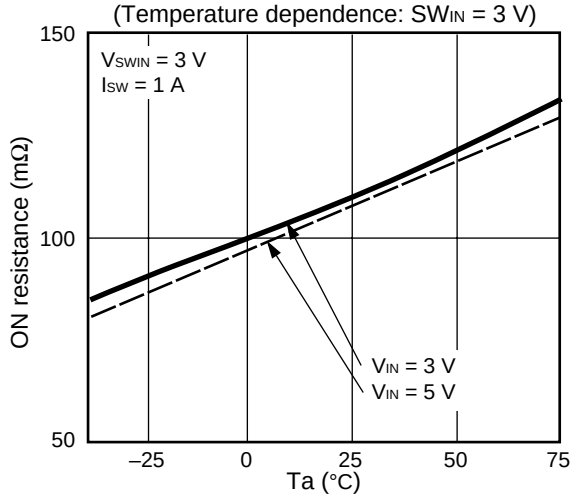
ON Resistance (Input-voltage dependence)



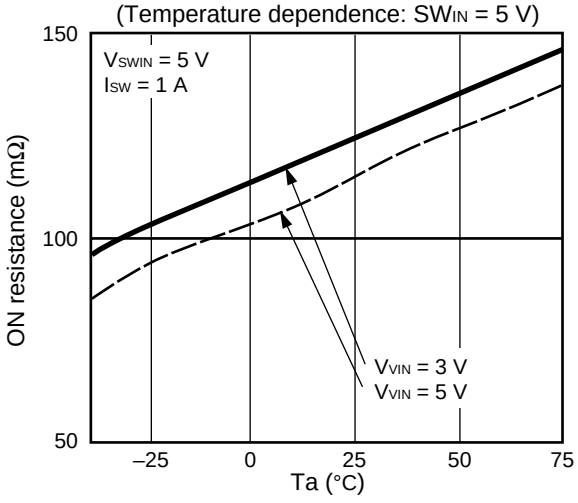
ON Resistance (Load current dependence)



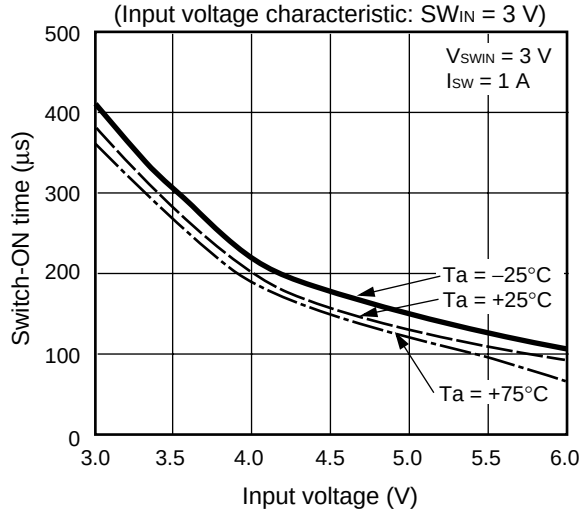
ON Resistance
(Temperature dependence: SW_{IN} = 3 V)



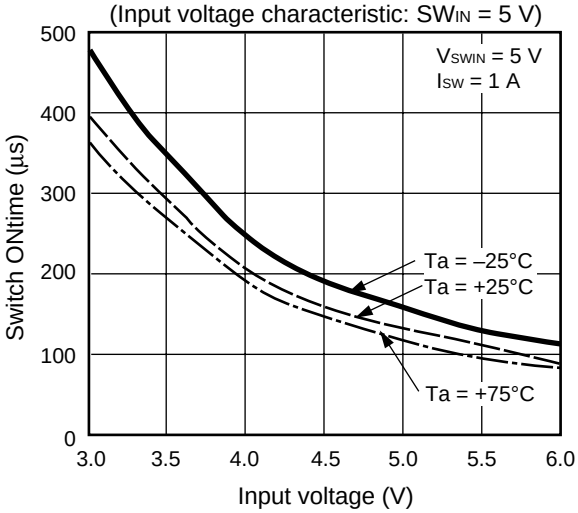
ON Resistance
(Temperature dependence: SW_{IN} = 5 V)



Switch-ON time
(Input voltage characteristic: SW_{IN} = 3 V)



Switch-ON time
(Input voltage characteristic: SW_{IN} = 5 V)



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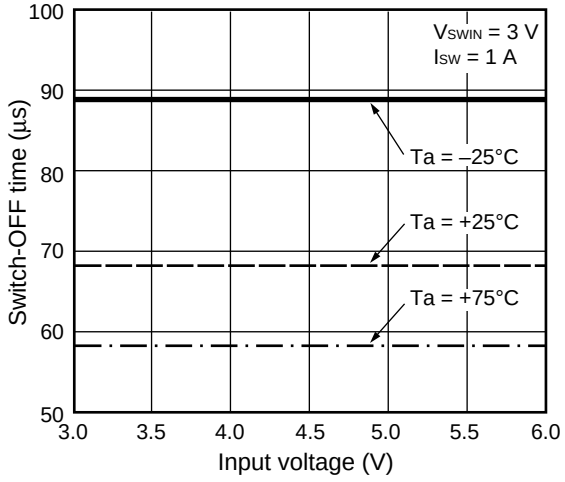
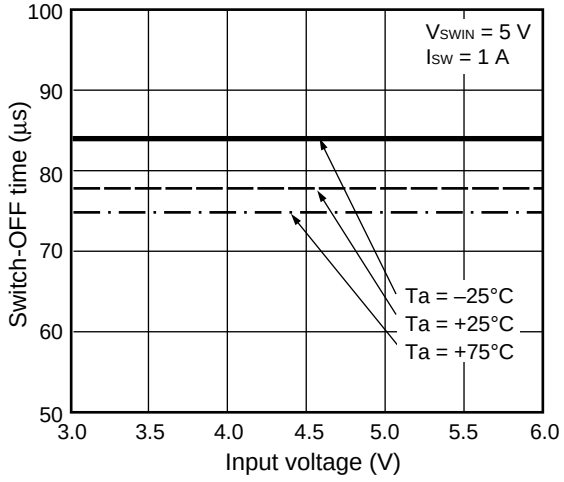
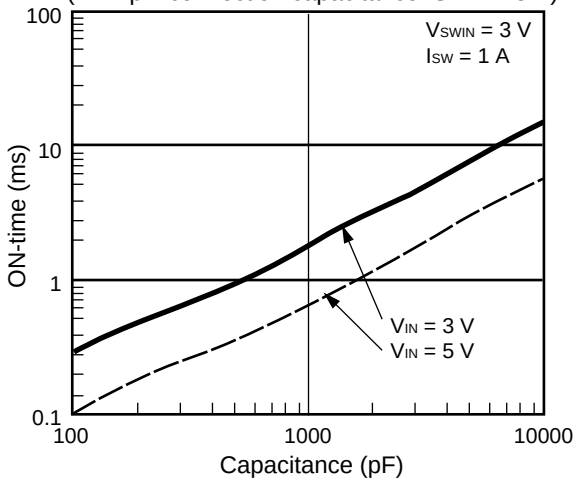
Switch-OFF Time
(Input voltage characteristic: SW_{IN} = 3 V)



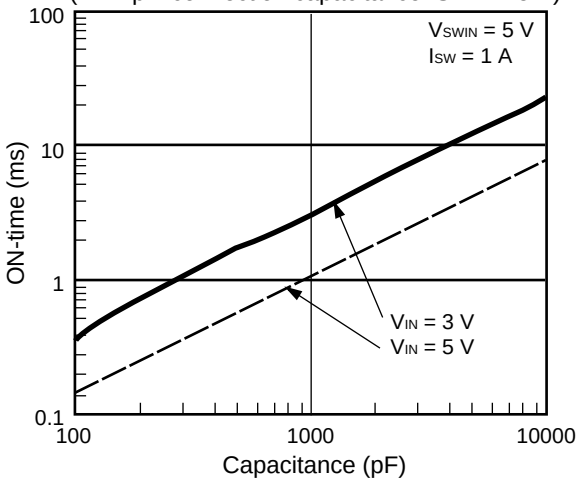
Switch-OFF Time
(Input voltage characteristic: SW_{IN} = 5 V)



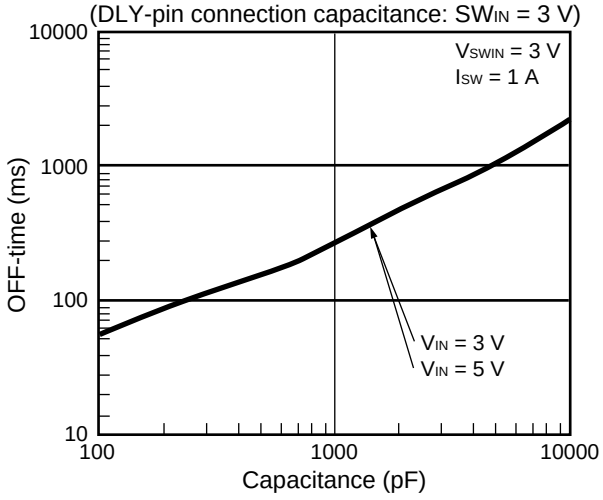
Switch-ON Time
(DLY-pin connection capacitance: SW_{IN} = 3 V)



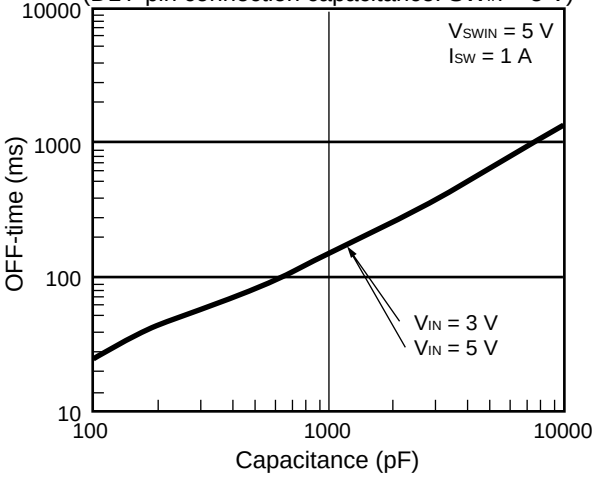
Switch-ON Time
(DLY-pin connection capacitance: SW_{IN} = 5 V)



Switch-OFF Time
(DLY-pin connection capacitance: SW_{IN} = 3 V)



Switch-OFF Time
(DLY-pin connection capacitance: SW_{IN} = 5 V)



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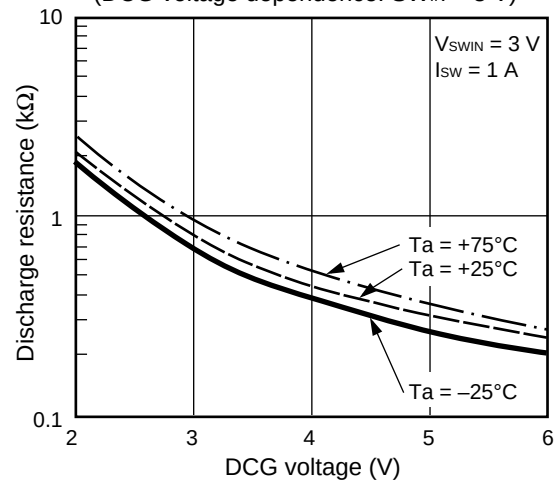
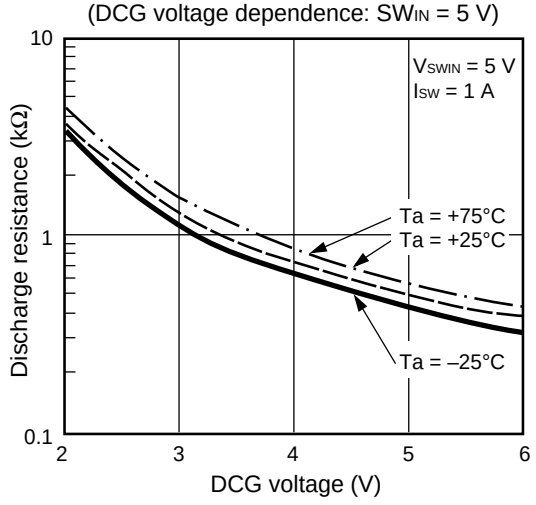
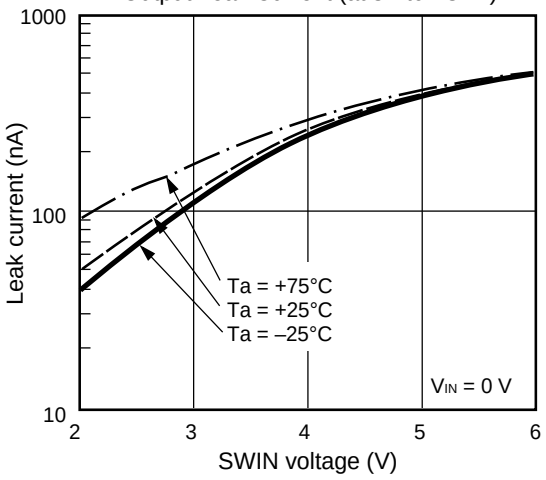
Discharge Resistance
(DCG voltage dependence: SW_{IN} = 3 V)



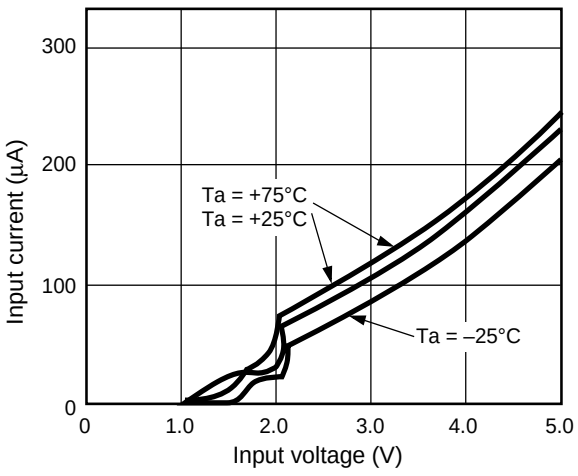
Discharge Resistance
(DCG voltage dependence: SW_{IN} = 5 V)



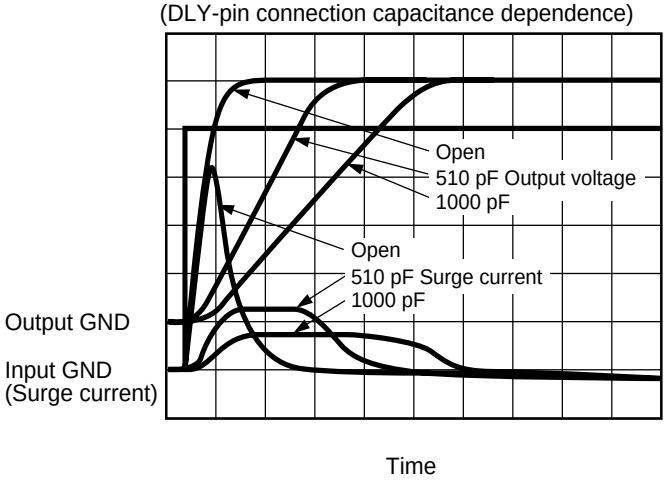
Output Leak Current (at switch OFF)



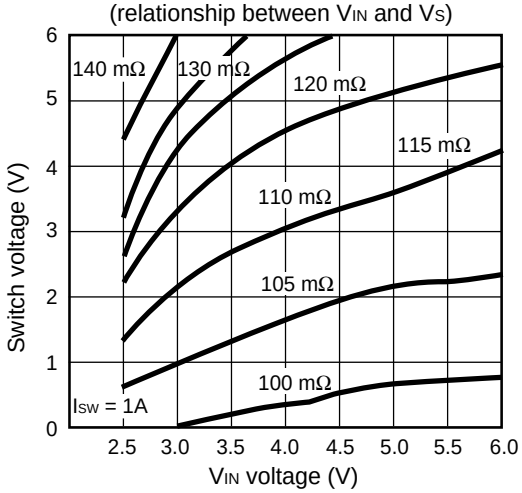
Input Current (Input voltage dependence)



Surge Current and Output Voltage Boot
(DLY-pin connection capacitance dependence)



Switch-On resistance
(relationship between V_{IN} and V_S)



V_{IN} = 0 → 5 V
SW_{IN} = 5 V
Load capacitance = 47 µF

V: 200 mA/div. (surge current)
V: 1.0 V/div. (output voltage)
H: 200 µs/div. (time axis)

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■ NOTES ON USE

- Take account of common impedance when designing the earth line on a printed wiring board.

- Take measures against static electricity.
  - For semiconductors, use antistatic or conductive containers.
  - When storing or carrying a printed circuit board after chip mounting, put it in a conductive bag or container.
  - The work table, tools and measuring instruments must be grounded.
  - The worker must put on a grounding device containing 250 kΩ to 1 MΩ resistors in series.

- Do not apply a negative voltage
  - Applying a negative voltage of –0.3 V or less to an LSI may generate a parasitic transistor, resulting in malfunction.

■ ORDERING INFORMATION

Part number	Package	Remarks
MB3802PF-G-BND	16-pin plastic SOP (FPT-16P-M04)	

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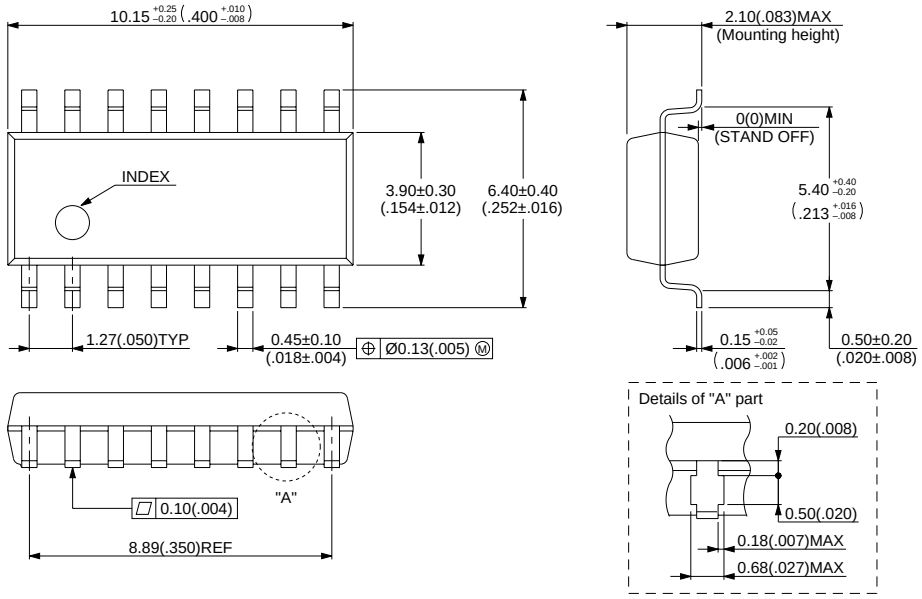
■ PACKAGE DIMENSION

16-pin plastic SOP
(FPT-16P-M04)



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Dimensions in mm (inches) .
Note : The values in parentheses are reference values.

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