

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.

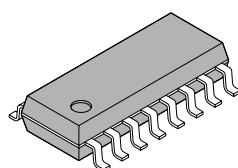
Moreover, the load-side capacitor is discharged at switch OFF, and the power supply for various power supply systems is switched efficiently.

■ FEATURES

- Extremely low ON resistance:
 $R_{ON} = 0.12 \Omega$ (typical)
 $R_{ON} = 0.06 \Omega$ (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) = $0 \mu A$, $V_{IN} = 0 V$
At switch ON: $I_{IN} = 230 \mu A$, $V_{IN} = 5 V$
- Load discharge function
- External control of ON/OFF time
- Break-before-make operation

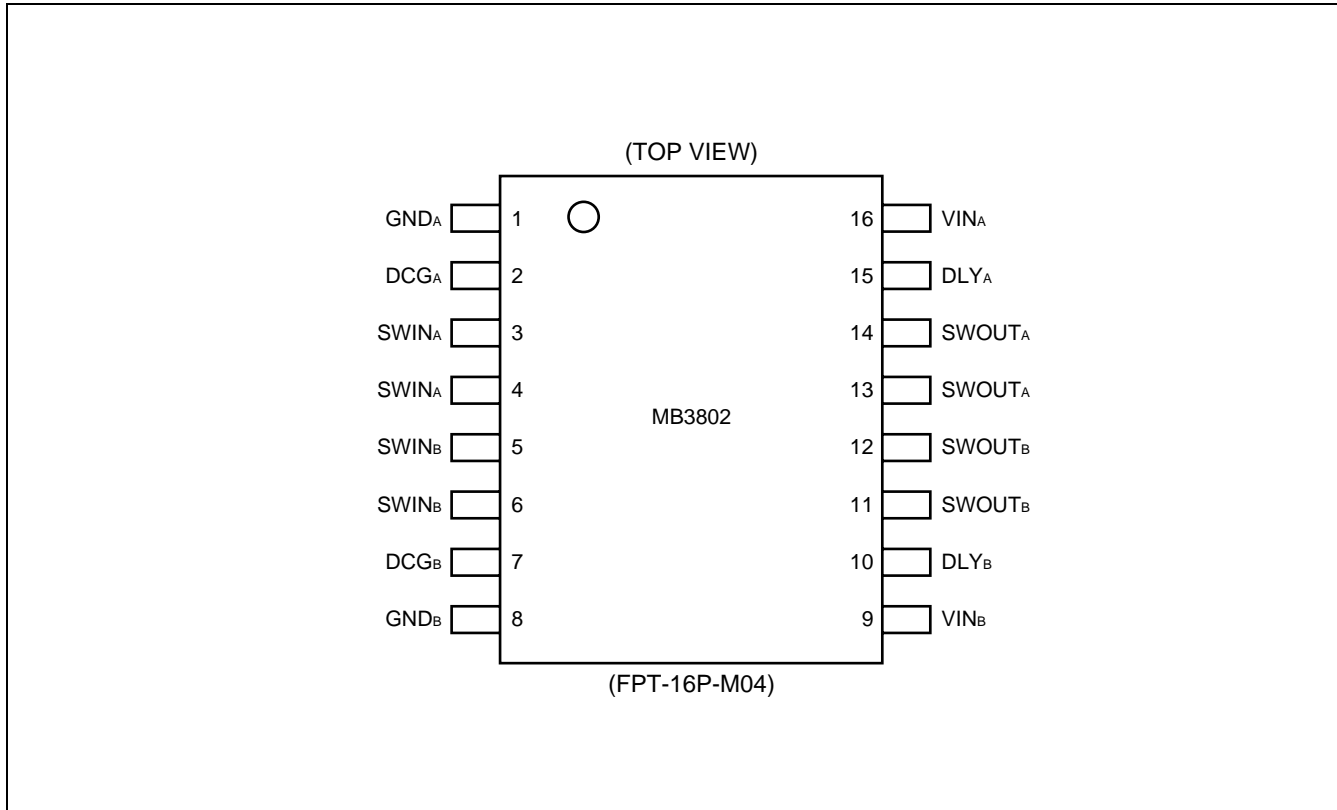
■ PACKAGE

16-pin plastic SOP



(FPT-16P-M04)

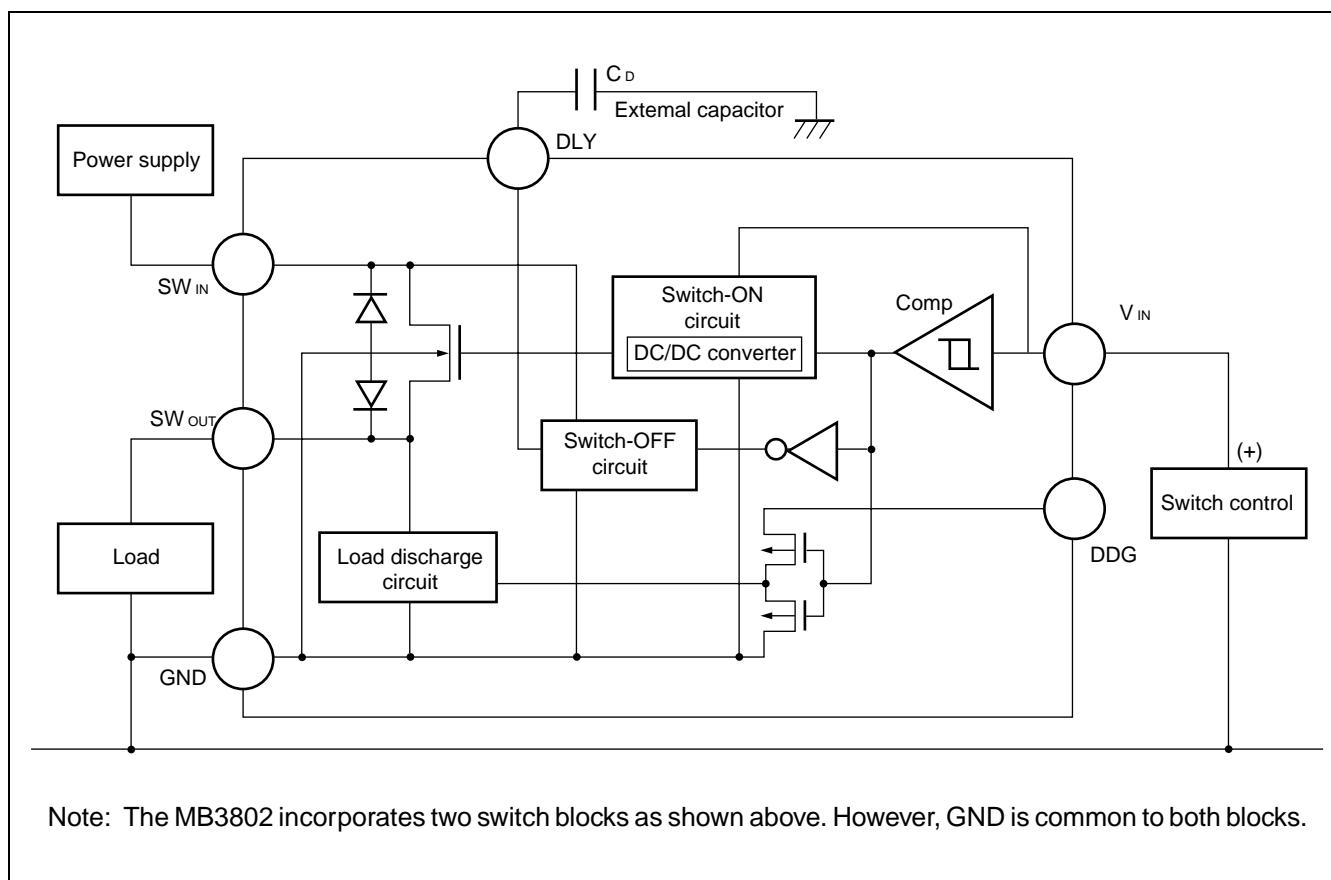
■ PIN ASSIGNMENT



■ PIN DESCRIPTION (SCSI Interface)

Pin No.	Pin symbol	Description
16	VIN _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	VIN _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 1.5V min.
5, 6	SWIN _B	
13, 14	SWOUT _A	Switch output pins: Two common pins are assigned to SWOUT _A and SWOUT _B . When DCG _A and DCG _B 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. 10V 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 μ A).
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	

■ BLOCK DIAGRAM AND EXTERNAL CONNECTIONS



■ BLOCK DESCRIPTION

The MB3802 is a one-way switching IC with the SW_{IN} and SW_{OUT} 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 V_{IN} 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 V_{IN} pin on/off with 1.5 V or less applied to the SW_{IN} 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 V_{IN} 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.

■ ABSOLUTE MAXIMUM RATING

(Ta = +25°C)

Parameter	Symbol	Condition	Ratings	Unit
Input Voltage	V _{IN}	—	−0.3 to 7.0	V
Switching voltage	V _{SW}	At switch OFF	−0.3 to 7.0	V
		At switch ON	−0.3 to 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 to +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	Ratings			Unit
			Min.	Typical	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} = 3V, 5V	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.

■ ELECTRICAL CHARACTERISTICS

1. DC Characteristics

(Ta = +25°C)

Parameter	Symbol	Condition	Ratings			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
Switching 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

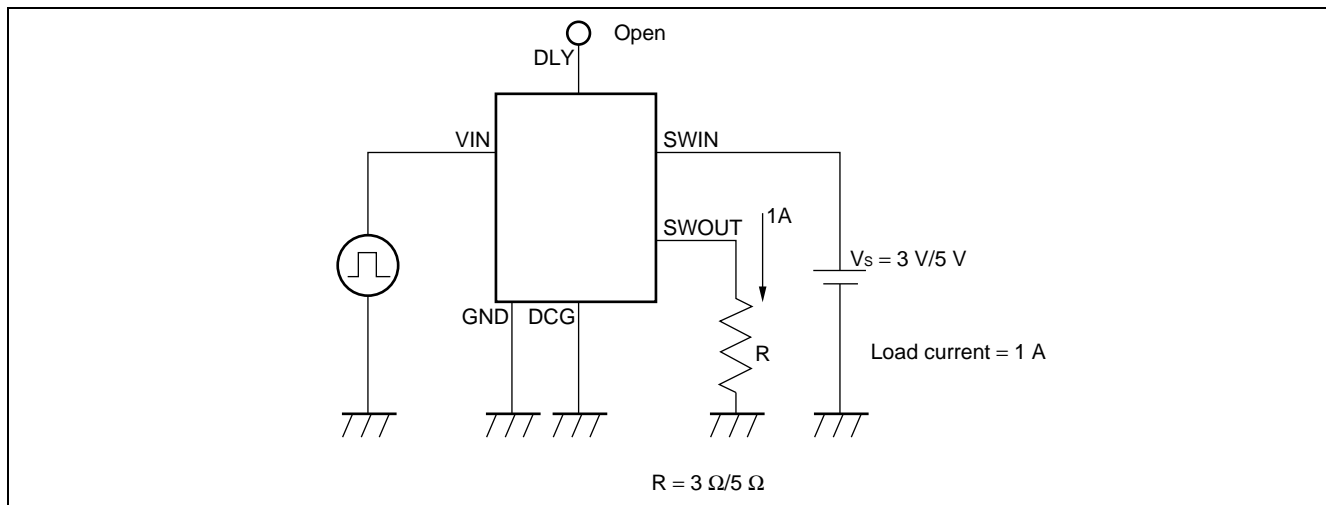
2. AC Characteristics

(Ta = +25°C)

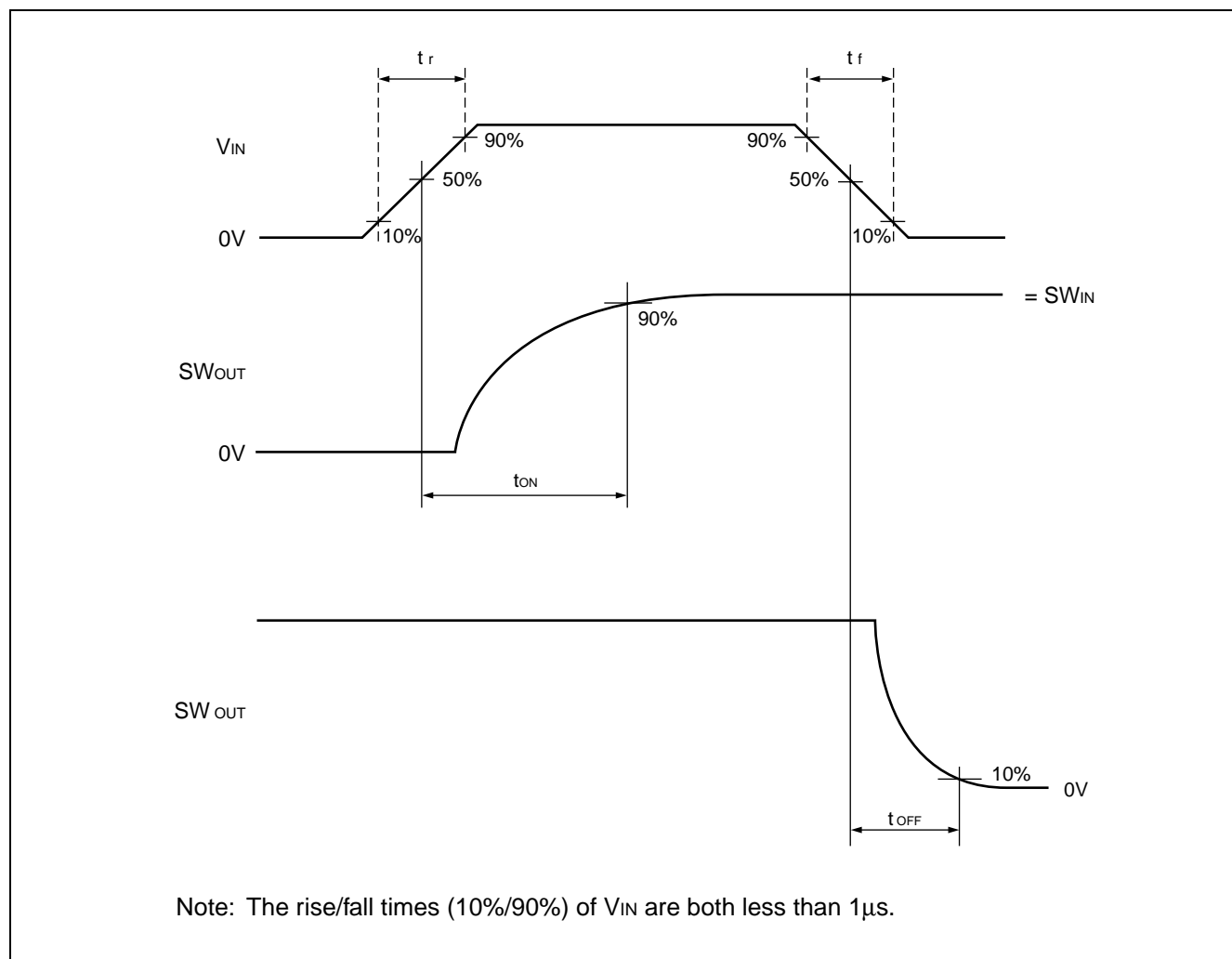
Parameter	Symbol	Condition	Ratings			Unit
			Min	Typ	Max	
Switch-ON time	t _{ON1}	V _{IN} = 0V → 3V, V _{SWIN} = 3V	20	300	900	μs
	t _{ON2}	V _{IN} = 0V → 5V, V _{SWIN} = 5V	20	150	450	μs
Switch OFF time	t _{OFF1}	V _{IN} = 3V → 0V, V _{SWIN} = 3V	5	60	180	μs
	t _{OFF2}	V _{IN} = 5V → 0V, V _{SWIN} =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

■ AC CHARACTERISTIC TEST DIAGRAMS

1. Test Condition

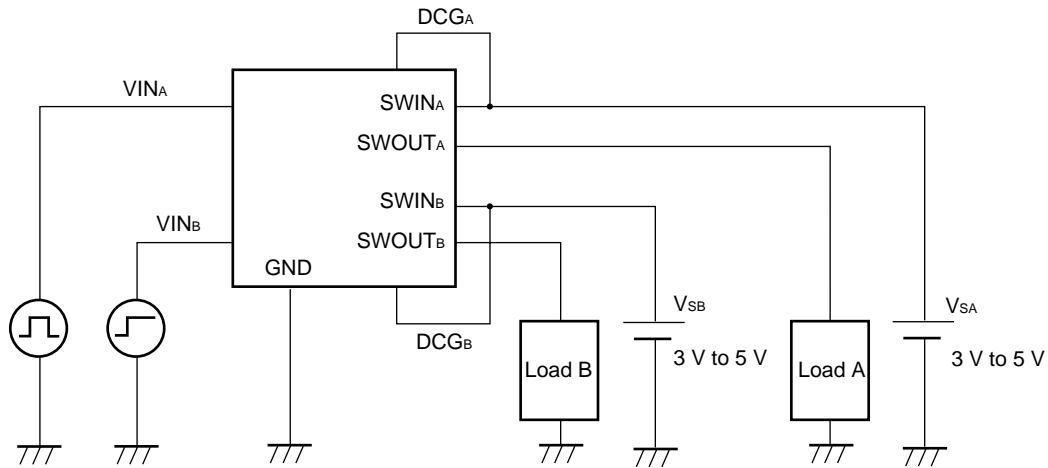


2. Switch-ON/OFF Timing Chart



■ APPLICATIONS

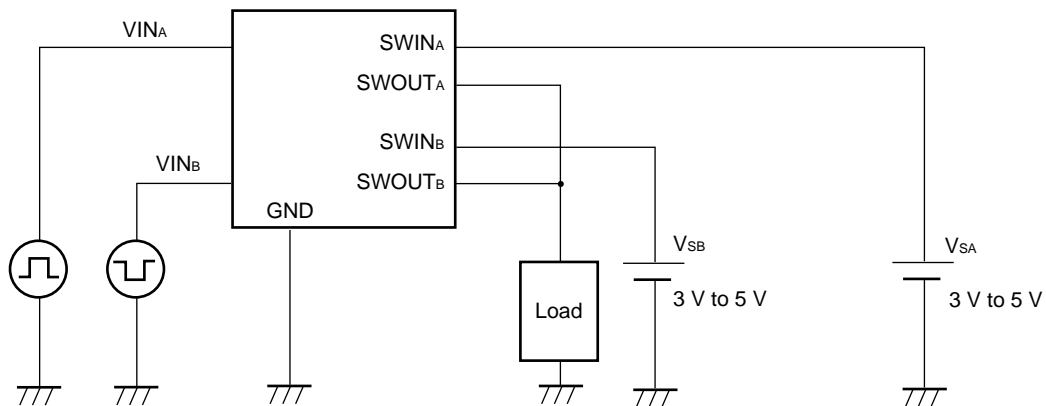
1. Separate Use of Two Switching Circuits



Notes:

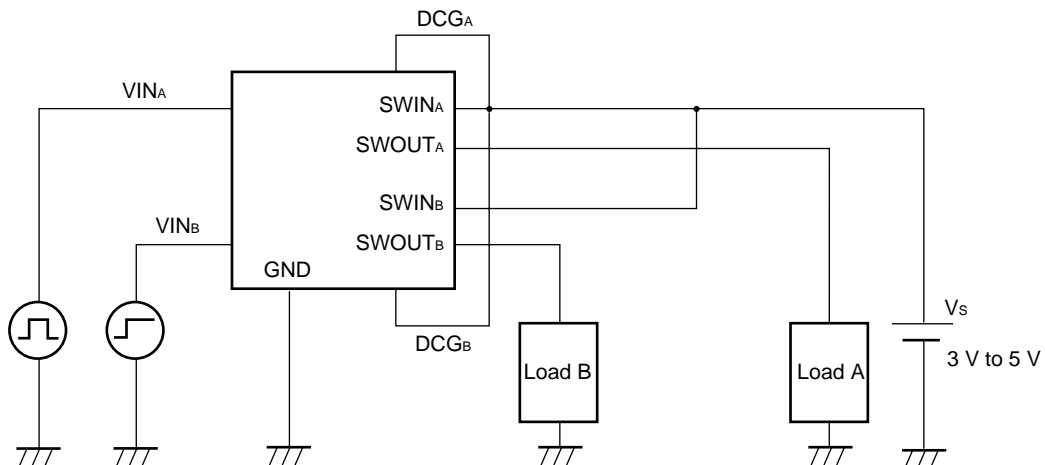
1. The two power supplies V_{SA} and V_{SB} can be used separated by controlling the voltages V_{INA} and V_{INB} .
2. Connect the DCD pin to GND when it is not used.

2. Switching Two Power Supplies



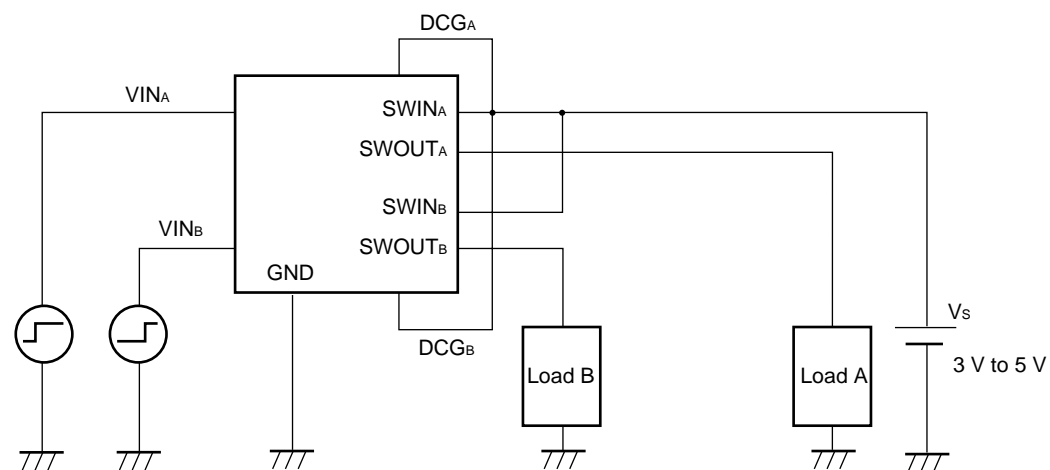
Note: When using different power supplies for a single load, control them by connecting an external capacitor so that both switches are not ON at the same time.

3. Switching Two Loads



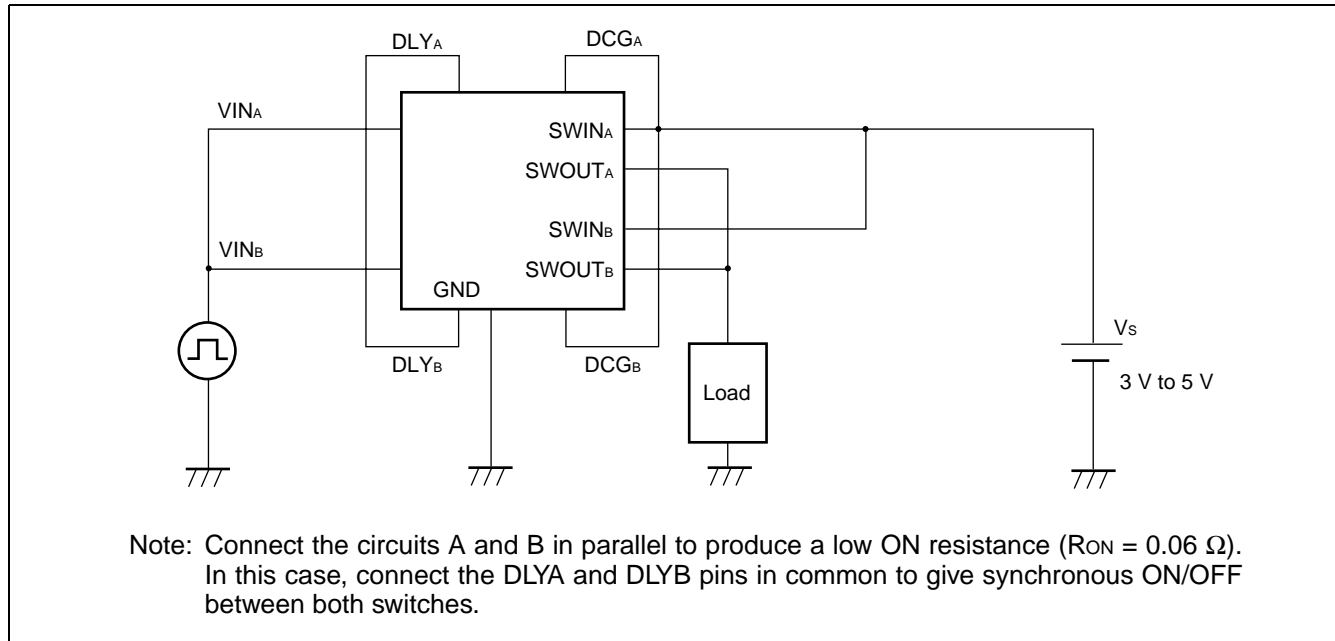
Note: Make this connection to control two different loads separately for a single power supply.

4. Connecting Serial Switches

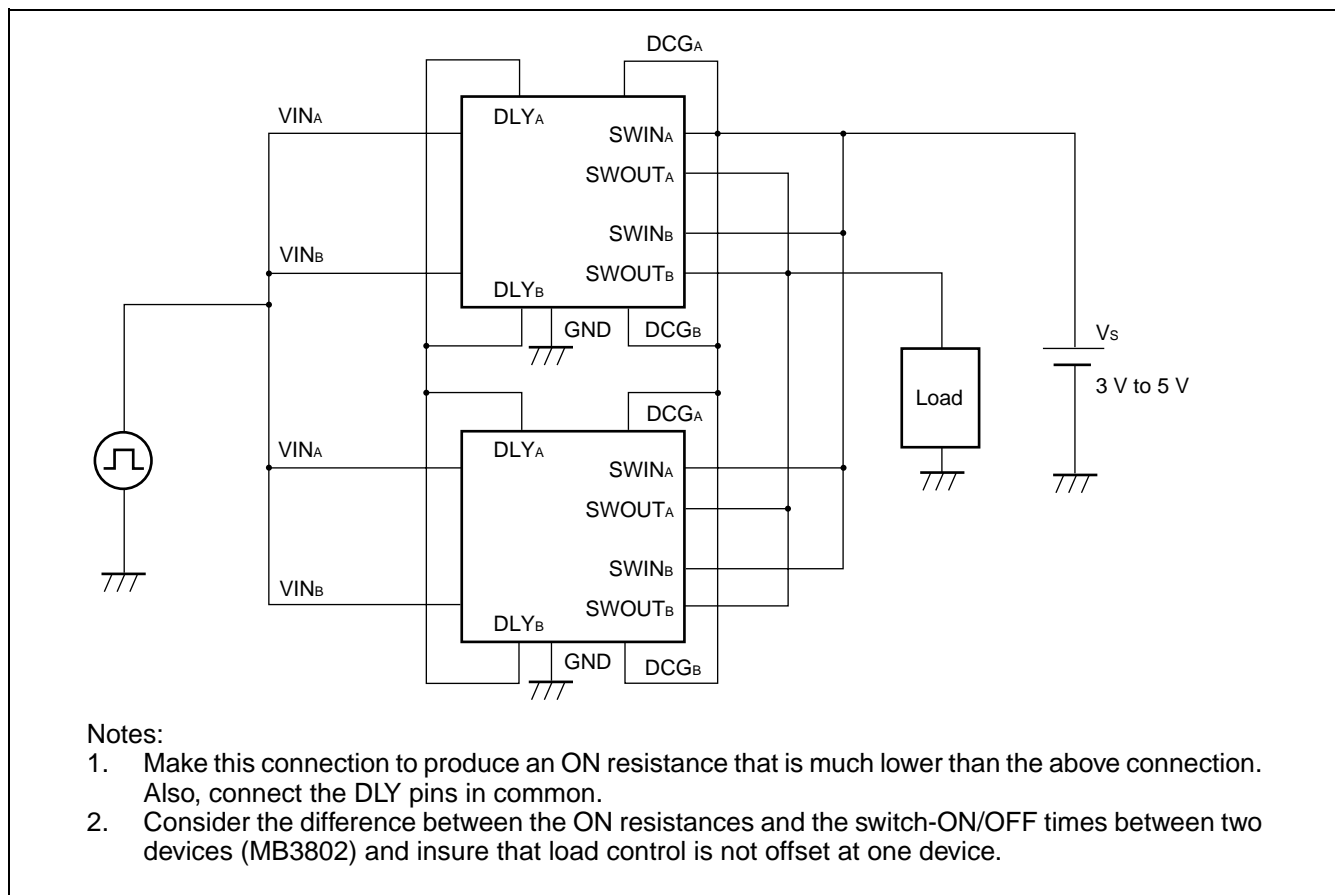


Note: Make this connection to supply power from V_s to load B via load A.

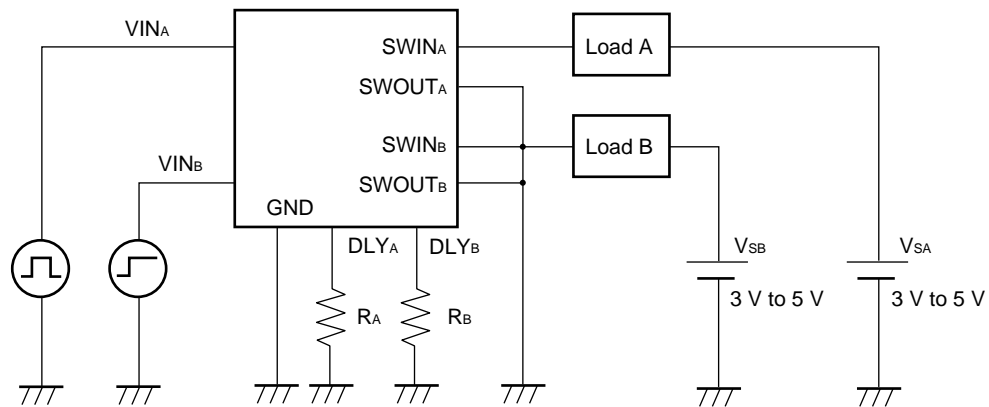
5. Connecting Parallel Switches



6. 25% ON Resistance



7. Low-side Switch



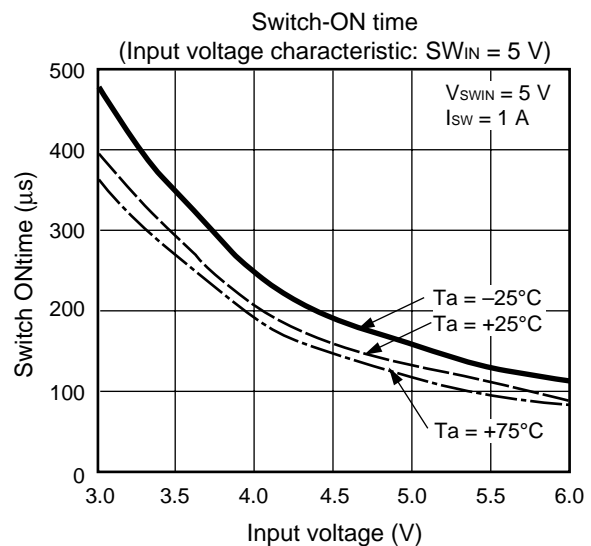
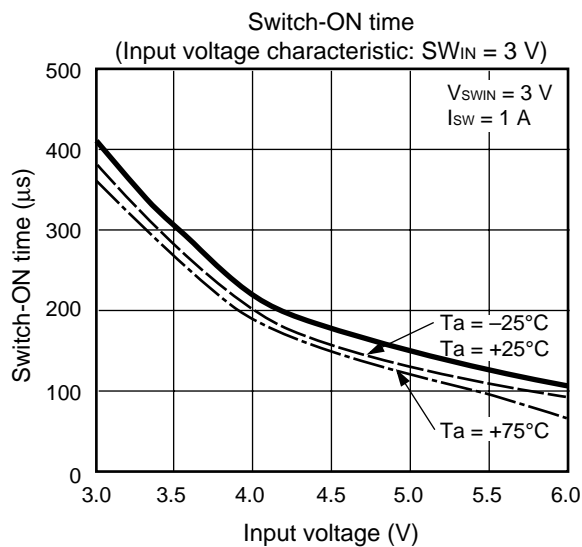
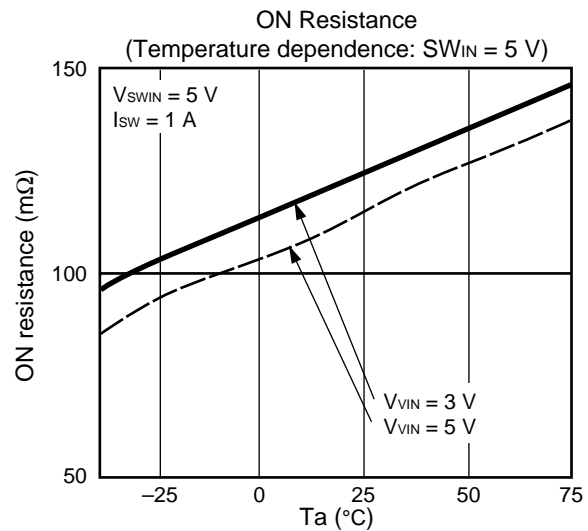
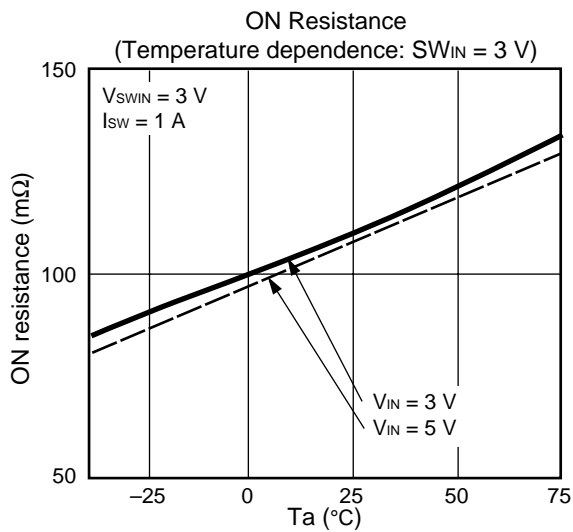
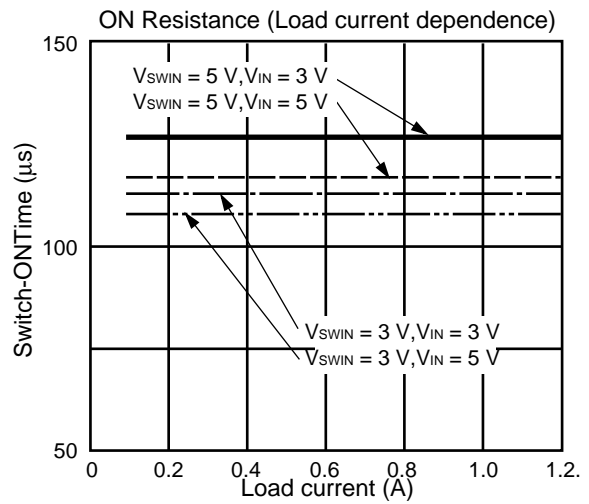
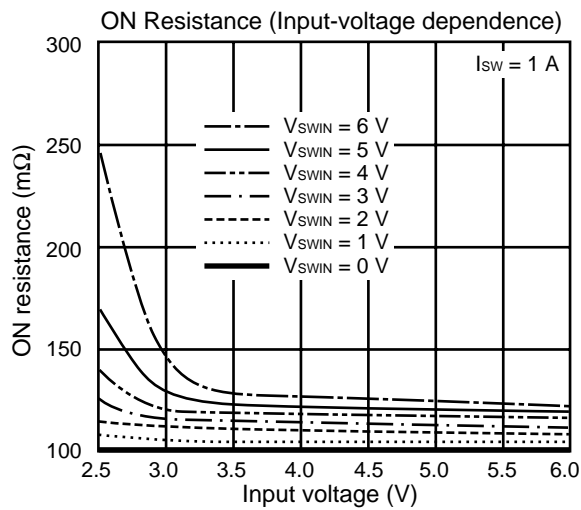
	$V_{IN} = 3\text{ V}, V_S = 3\text{ V}$	$V_{IN} = 5\text{ V}, V_S = 5\text{ V}$
Switch-ON time	80 μs	45 μs
Switch-OFF time	5.0 ms	3.5 ms

R_A and $R_B = 10\text{ M}\Omega$

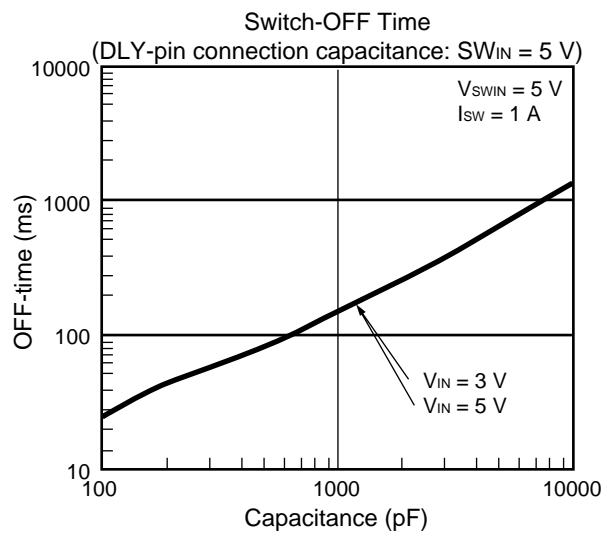
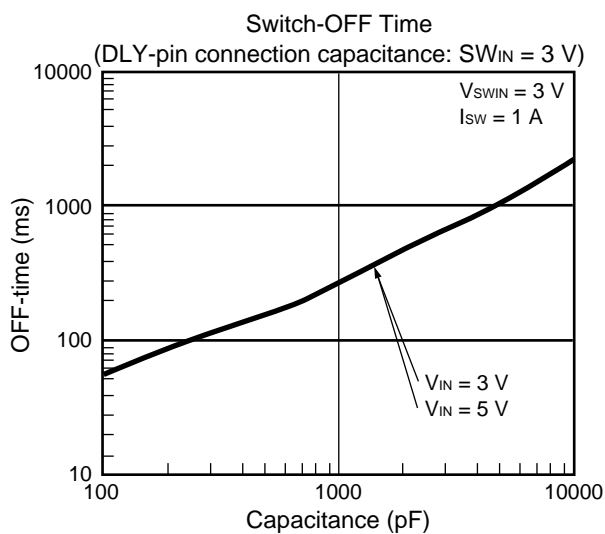
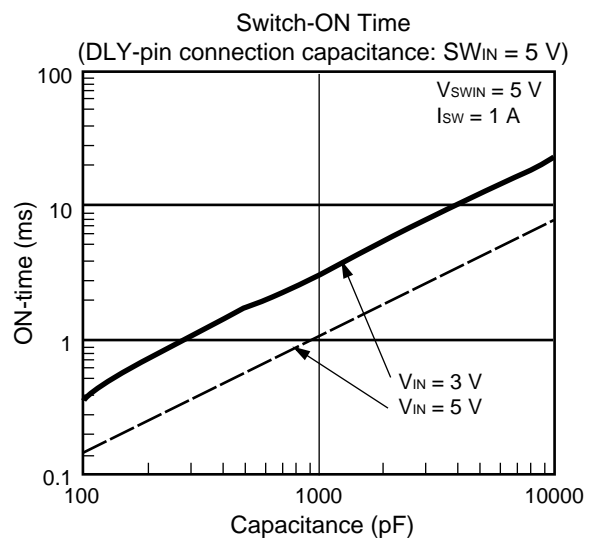
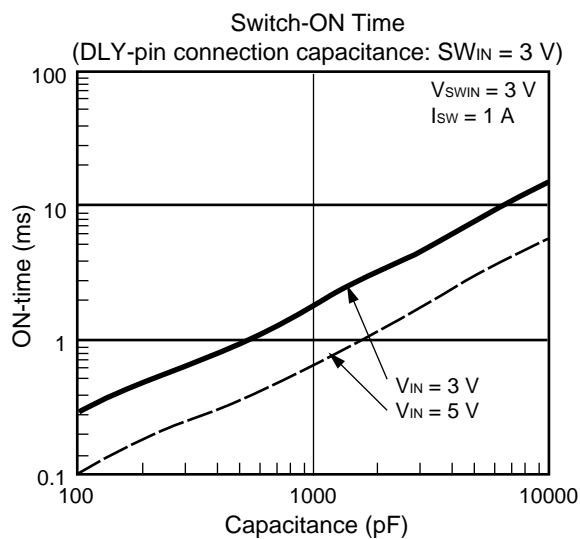
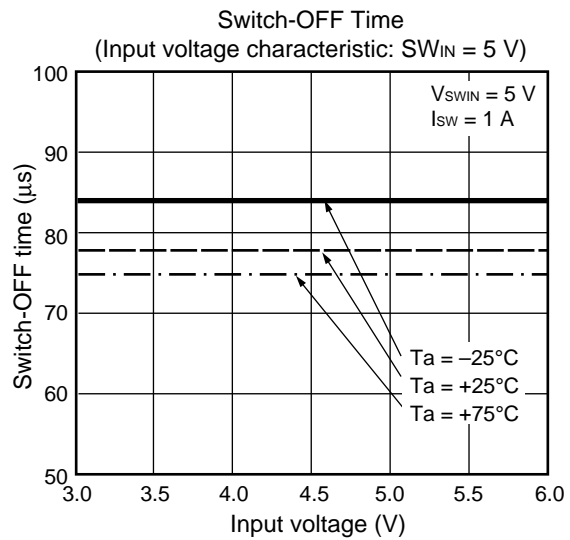
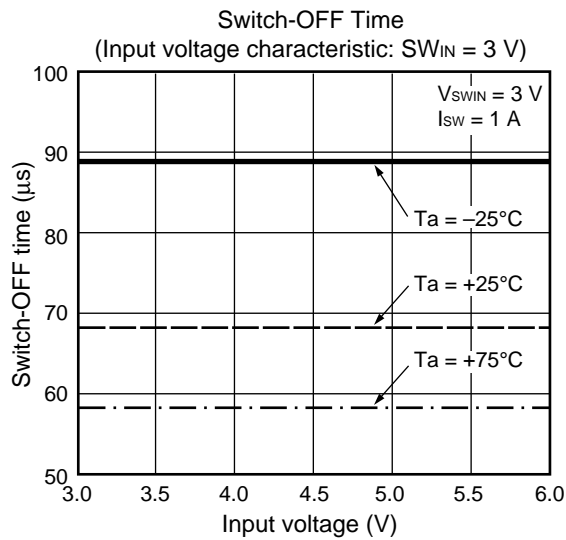
Notes:

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

■ TYPICAL PERFORMANCE CHARACTERISTICS

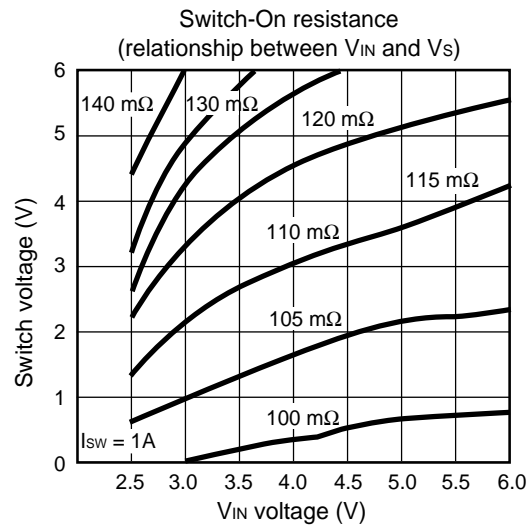
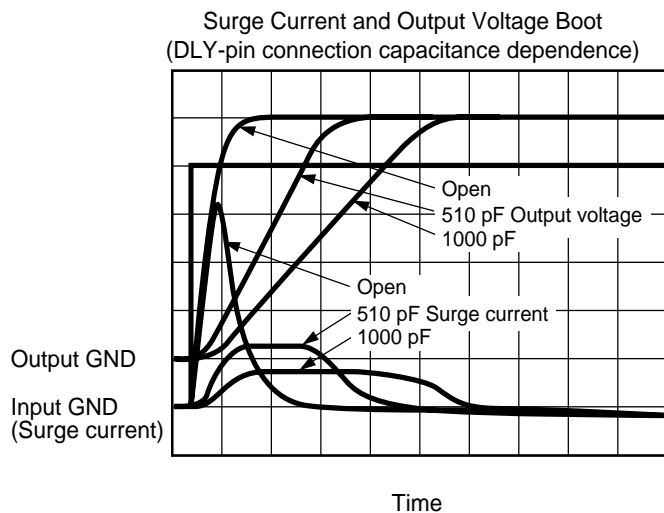
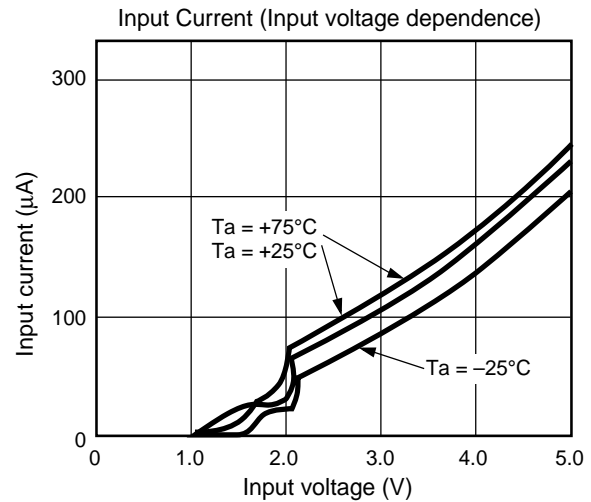
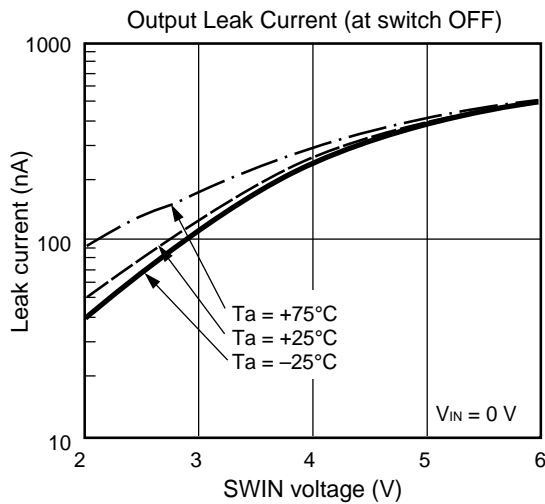
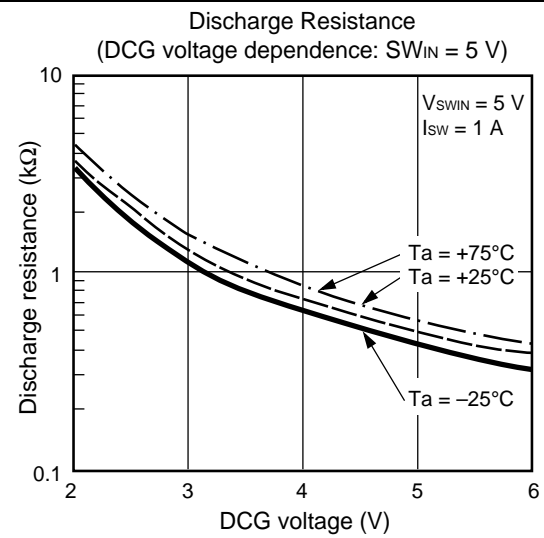
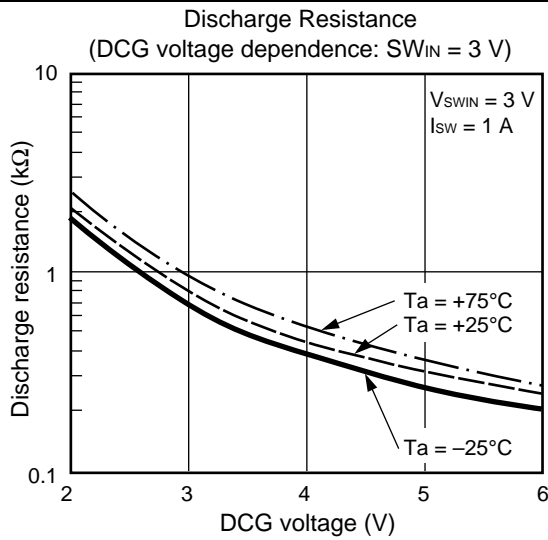


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$V_{IN} = 0 \rightarrow 5\text{ V}$

$SW_{IN} = 5\text{ V}$

Load capacitance = 47 μF

V: 200 mA/div. (surge current)

V: 1.0 V/div. (output voltage)

H: 200 μs /div. (time axis)

FUJITSU LIMITED

For further information please contact:

Japan

FUJITSU LIMITED
Corporate Global Business Support Division
Electronic Devices
KAWASAKI PLANT, 4-1-1, Kamikodanaka
Nakahara-ku, Kawasaki-shi
Kanagawa 211-8588, Japan
Tel: 81(44) 754-3763
Fax: 81(44) 754-3329

<http://www.fujitsu.co.jp/>

North and South America

FUJITSU MICROELECTRONICS, INC.
Semiconductor Division
3545 North First Street
San Jose, CA 95134-1804, USA
Tel: (408) 922-9000
Fax: (408) 922-9179

Customer Response Center
Mon. - Fri.: 7 am - 5 pm (PST)
Tel: (800) 866-8608
Fax: (408) 922-9179

<http://www.fujitsumicro.com/>

Europe

FUJITSU MIKROELEKTRONIK GmbH
Am Siebenstein 6-10
D-63303 Dreieich-Buchsschlag
Germany
Tel: (06103) 690-0
Fax: (06103) 690-122

<http://www.fujitsu-edc.com/>

Asia Pacific

FUJITSU MICROELECTRONICS ASIA PTE LTD
#05-08, 151 Lorong Chuan
New Tech Park
Singapore 556741
Tel: (65) 281-0770
Fax: (65) 281-0220

<http://www.fmap.com.sg/>

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