

## 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.

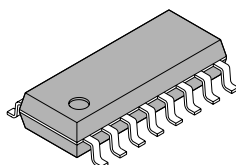
Moreover, the load-side capacitor is discharged at switch OFF, and the power supply for various power supply systems is switched efficiently.

### ■ 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

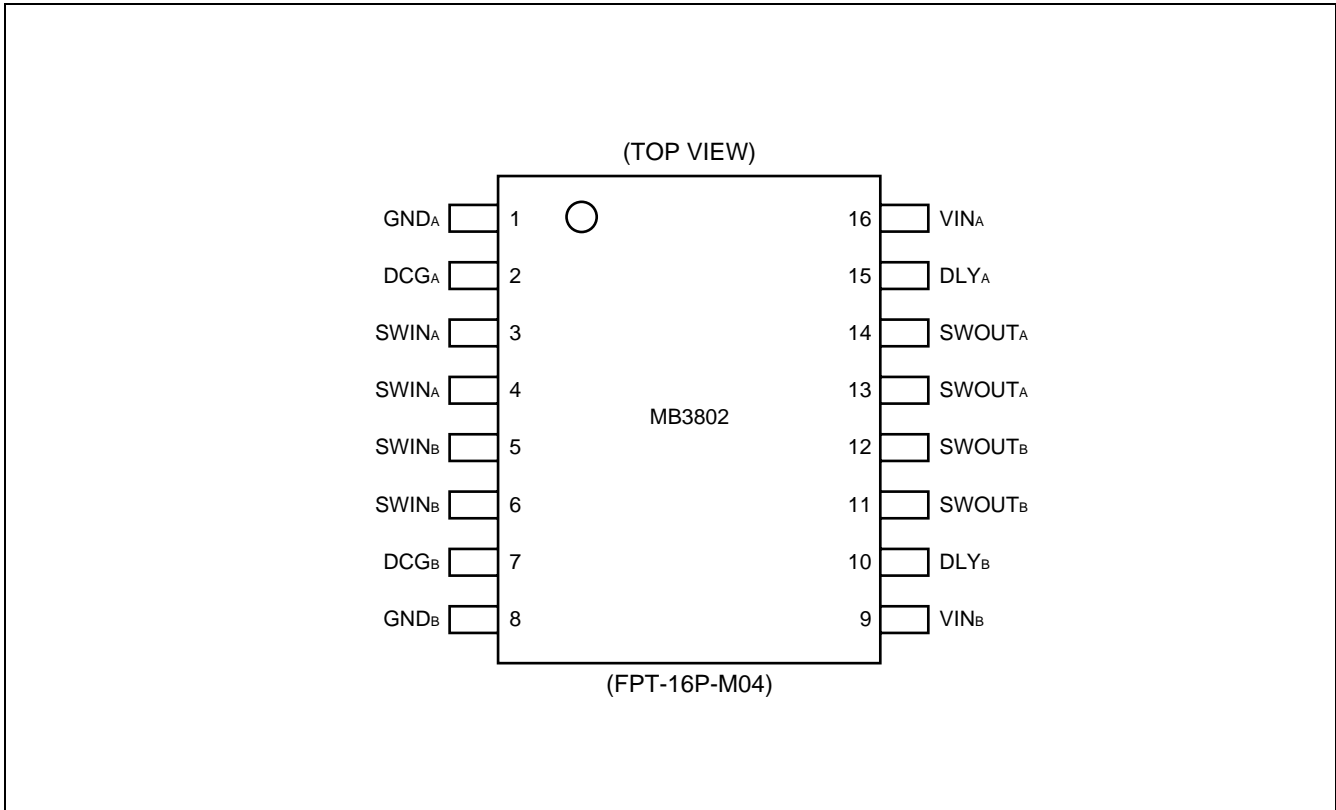
### ■ PACKAGE

16-pin plastic SOP



(FPT-16P-M04)

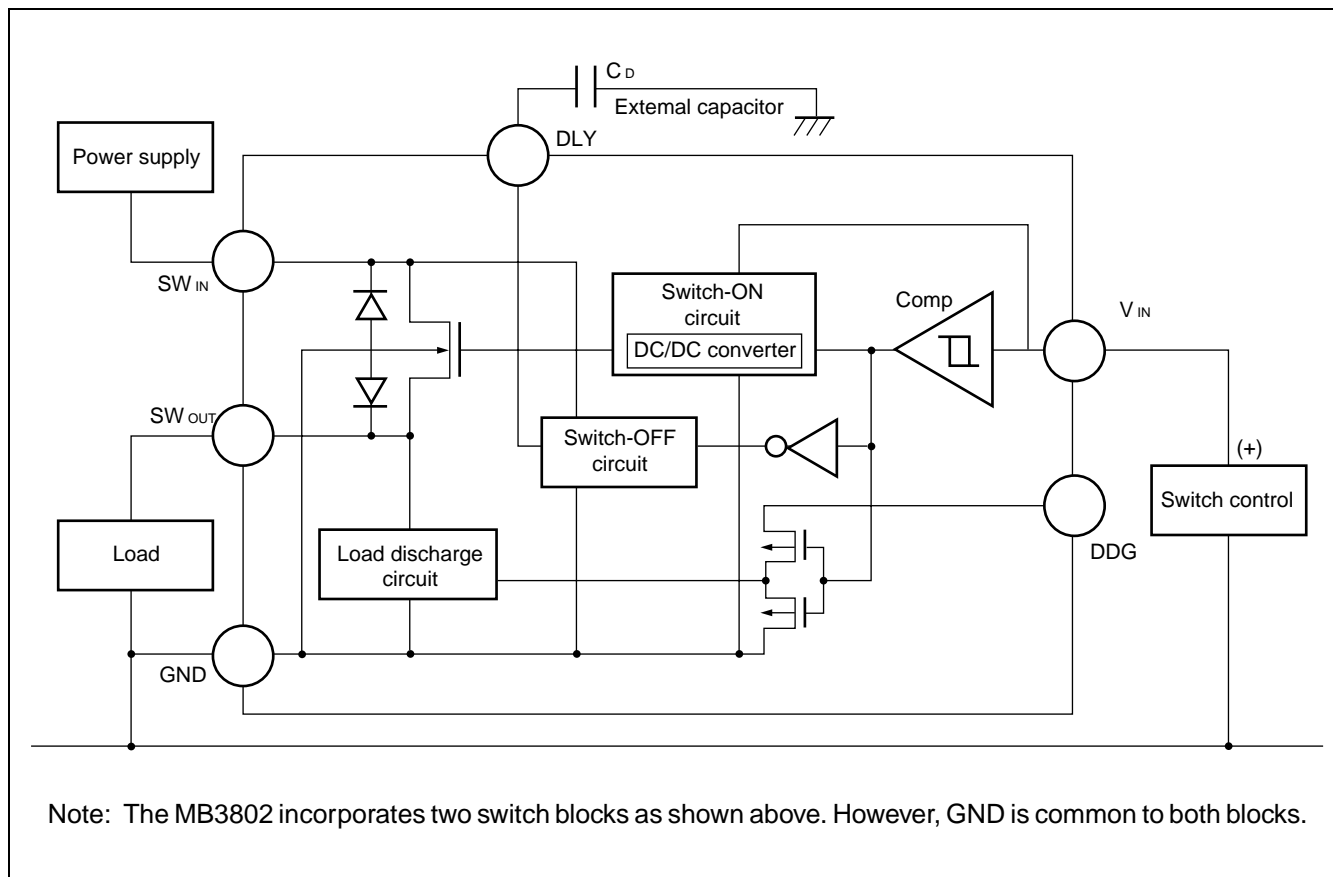
## ■ PIN ASSIGNMENT



## ■ PIN DESCRIPTION (SCSI Interface)

Pin No.	Pin symbol	Description
16	VIN <sub>A</sub>	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 <sub>B</sub>	
3, 4	SWIN <sub>A</sub>	<b>Switch Input pins:</b> Two common pins are assigned to SWIN <sub>A</sub> and SWIN <sub>B</sub> . They serve as power-supply pins for the switch-OFF circuit which starts at 1.5V min.
5, 6	SWIN <sub>B</sub>	
13, 14	SWOUT <sub>A</sub>	<b>Switch output pins:</b> Two common pins are assigned to SWOUT <sub>A</sub> and SWOUT <sub>B</sub> . When DCG <sub>A</sub> and DCG <sub>B</sub> are High level, the load-discharge circuit starts discharge via these pins.
11, 12	SWOUT <sub>B</sub>	
2	DCG <sub>A</sub>	<b>SWOUT<sub>A</sub>/SWOUT<sub>B</sub>-side discharge control pins:</b> 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 <sub>B</sub>	
15	DLY <sub>A</sub>	<b>Switch-ON/OFF control pins:</b> 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 μA).
10	DLY <sub>B</sub>	
1	GND <sub>A</sub>	<b>Ground pins for input threshold reference voltage and load discharge:</b> When two switching circuits are used, ground both GND pins.
8	GND <sub>B</sub>	

## ■ BLOCK DIAGRAM AND EXTERNAL CONNECTIONS



## ■ BLOCK DESCRIPTION

The MB3802 is a one-way switching IC with the SW<sub>IN</sub> and SW<sub>OUT</sub> pins serving respectively for input and output. When V<sub>IN</sub> 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<sub>IN</sub> voltage.

When V<sub>IN</sub> 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<sub>IN</sub> 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<sub>IN</sub> and SW<sub>OUT</sub>. Note, however, that turning the V<sub>IN</sub> pin on/off with 1.5 V or less applied to the SW<sub>IN</sub> 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<sub>OUT</sub> 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<sub>IN</sub> level is high and the SW<sub>IN</sub> level is low, the switch-ON time is small; when the SW<sub>IN</sub> level is high, the switch-OFF time is small.

# MB3802

## ■ ABSOLUTE MAXIMUM RATING

(Ta = +25°C)

Parameter	Symbol	Condition	Ratings	Unit
Input Voltage	V <sub>IN</sub>	—	-0.3 to 7.0	V
Switching voltage	V <sub>SW</sub>	At switch OFF	-0.3 to 7.0	V
		At switch ON	-0.3 to 7.0	
Switching current	I <sub>SW</sub>	At switch-ON peak	3.6	A
Permissible loss	P <sub>D</sub>	Ta ≤ +75°C	290	mW
Storage Temperature	T <sub>STG</sub>	—	-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 <sub>IN</sub>	—	0	—	6.0	V
Switching level	V <sub>SWIN</sub>	At switch ON	0	—	6.0	V
		At switch OFF	0	—	6.0	
Switching current	I <sub>SW</sub>	At switch on (for single switch)	—	—	1.2	A
Gate-pin connection capacitance	C <sub>D</sub>	—	—	—	10	nF
Gate-pin mounting leak current	I <sub>DLY</sub>	—	-0.1	—	0.1	μA
Input voltage to load discharge circuit	V <sub>DGC</sub>	V <sub>IN</sub> = 3V, 5V	2.5	—	6.0	V
Operating temperature	T <sub>op</sub>	—	-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 <sub>IN1</sub>	V <sub>IN</sub> = 0 V	—	0	—	μA
	I <sub>IN2</sub>	V <sub>IN</sub> = 3 V	—	100	200	μA
		V <sub>IN</sub> = 5 V	—	230	460	μA
Switching resistance	R <sub>ON1</sub>	V <sub>IN</sub> = 3 V, I <sub>SW</sub> = 0.5 A, V <sub>SWIN</sub> = 3 V	—	120	160	mΩ
	R <sub>ON2</sub>	V <sub>IN</sub> = 5 V, I <sub>SW</sub> = 0.5 A, V <sub>SWIN</sub> = 3 V	—	130	175	mΩ
Switch-OFF leak current	I <sub>L</sub>	V <sub>IN</sub> = 0 V, V <sub>SWIN</sub> = 6 V	—	0.5	2.0	μA
Input threshold voltage	V <sub>TH1</sub>	At switch ON	2.0	2.2	2.4	V
	V <sub>TH2</sub>	At switch OFF	1.9	2.1	2.3	V
Input hysteresis width	V <sub>HYS</sub>	—	50	100	—	mV
Switch resistance	R <sub>ON</sub>	V <sub>IN</sub> = 3 V, 5 V, I <sub>SW</sub> = 0.5 A Ta = -40°C to +75°C	—	—	210	mΩ
Switch charge resistance	R <sub>DCG1</sub>	V <sub>SWOUT</sub> = 3 V, V <sub>DCG</sub> = 3 V	—	750	1500	Ω
	R <sub>DCG2</sub>	V <sub>SWOUT</sub> = 5 V, V <sub>DCG</sub> = 5 V	—	500	1000	Ω
Input voltage to switch charge circuit	I <sub>DCG</sub>	V <sub>DCG</sub> = 5 V	—	0	2	μA

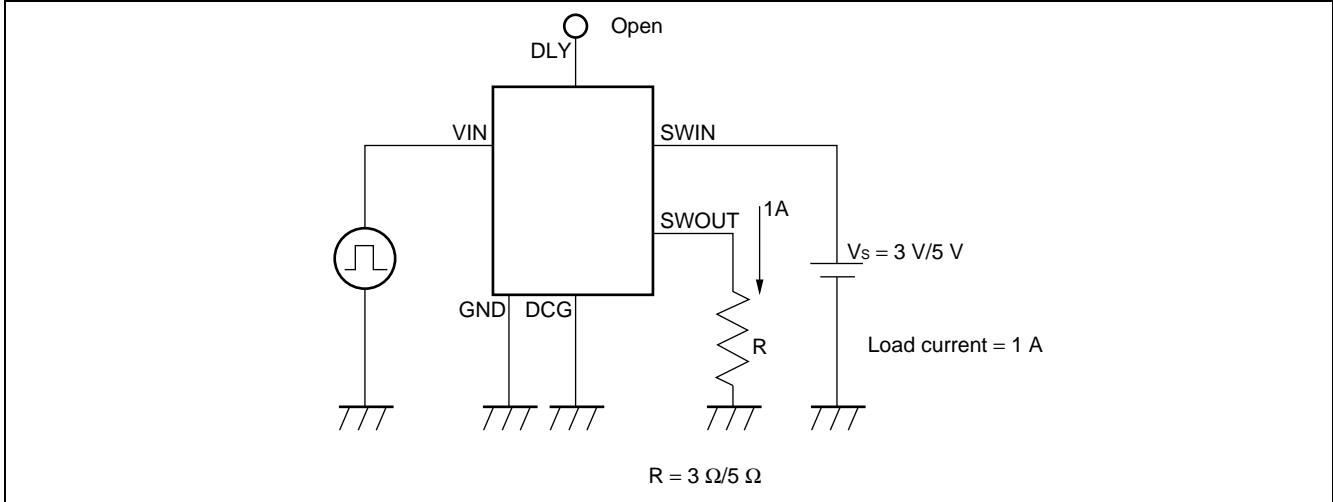
### 2. AC Characteristics

(Ta = +25°C)

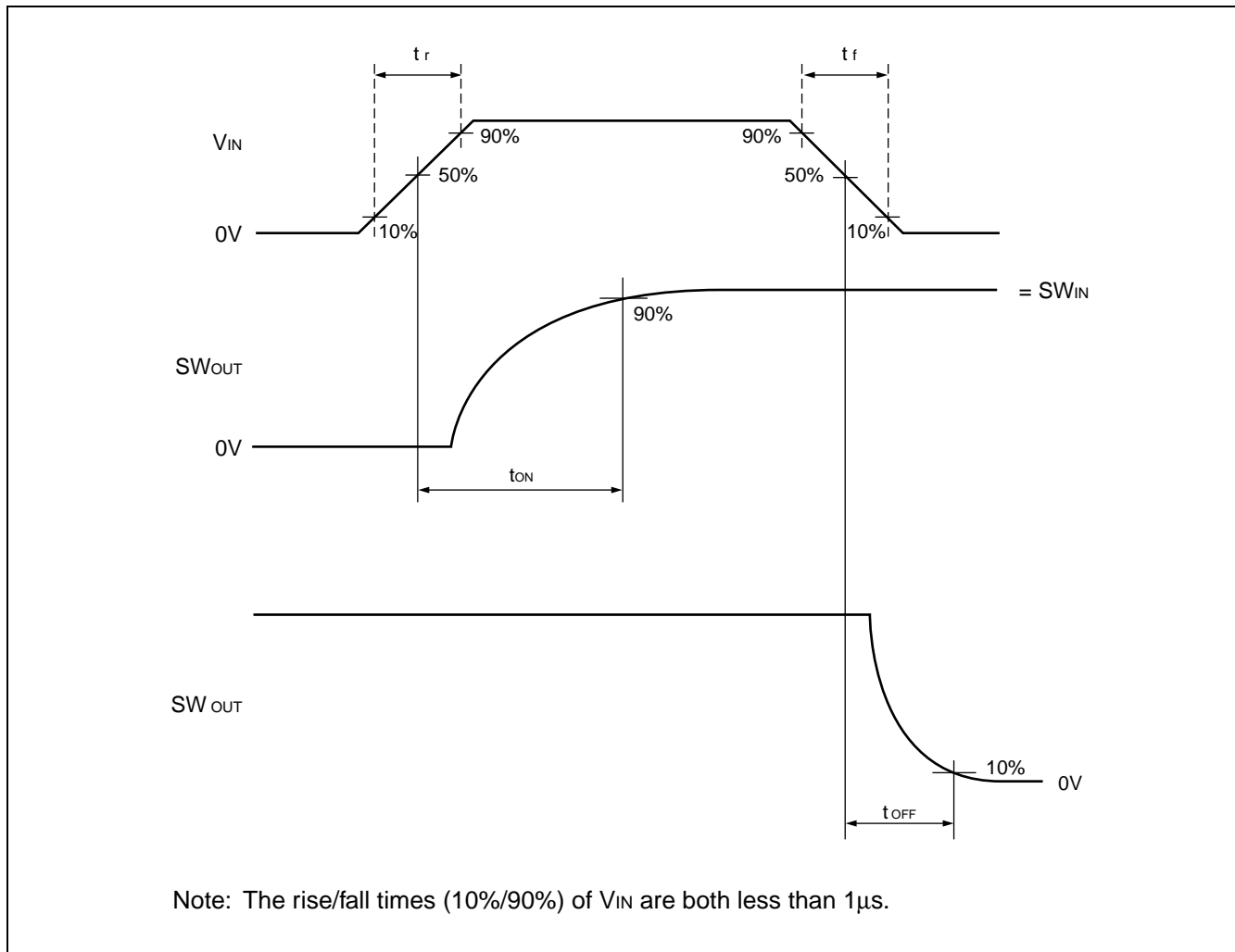
Parameter	Symbol	Condition	Ratings			Unit
			Min	Typ	Max	
Switch-ON time	t <sub>ON1</sub>	V <sub>IN</sub> = 0V → 3V, V <sub>SWIN</sub> = 3V	20	300	900	μs
	t <sub>ON2</sub>	V <sub>IN</sub> = 0V → 5V, V <sub>SWIN</sub> = 5V	20	150	450	μs
Switch OFF time	t <sub>OFF1</sub>	V <sub>IN</sub> = 3V → 0V, V <sub>SWIN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

## ■ AC CHARACTERISTIC TEST DIAGRAMS

### 1. Test Condition

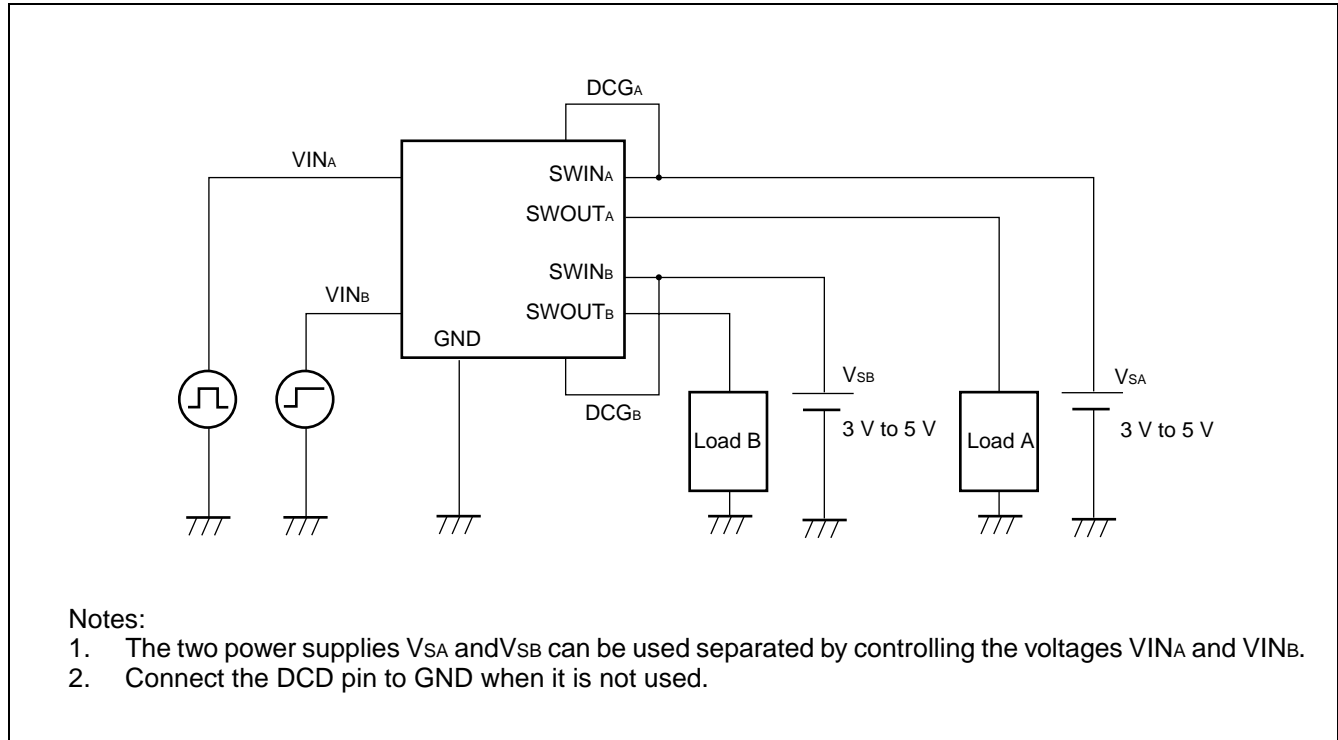


### 2. Switch-ON/OFF Timing Chart

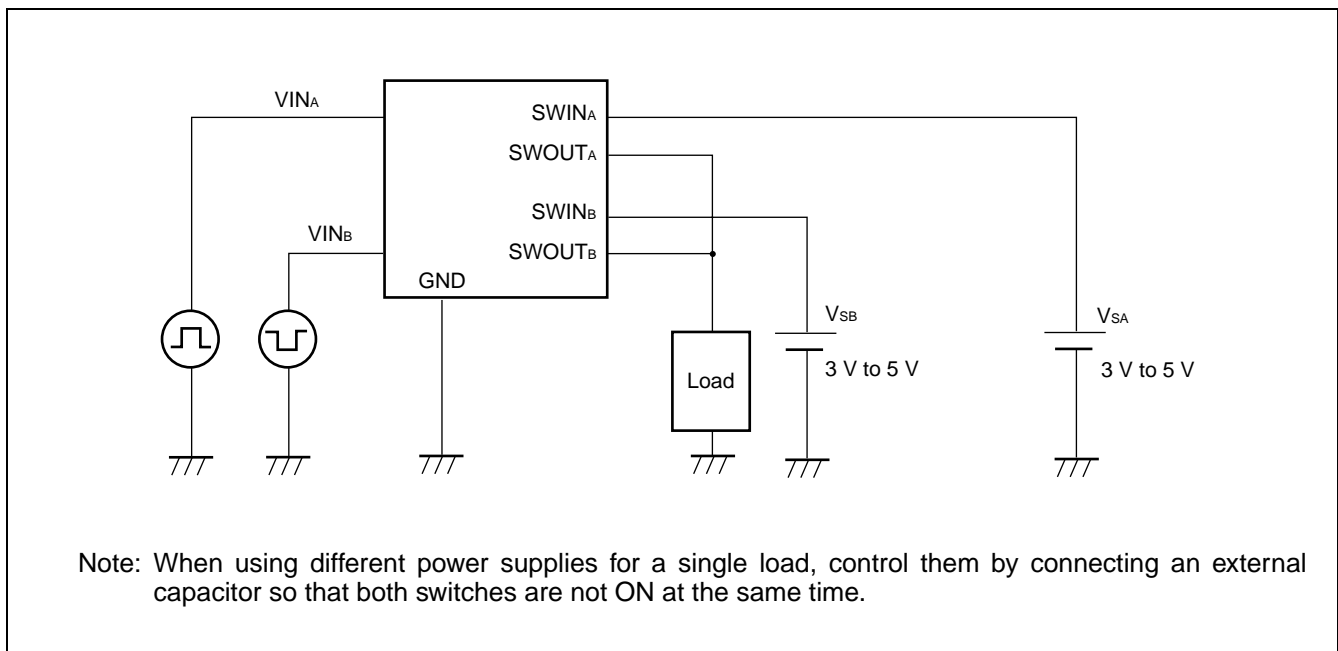


## ■ APPLICATIONS

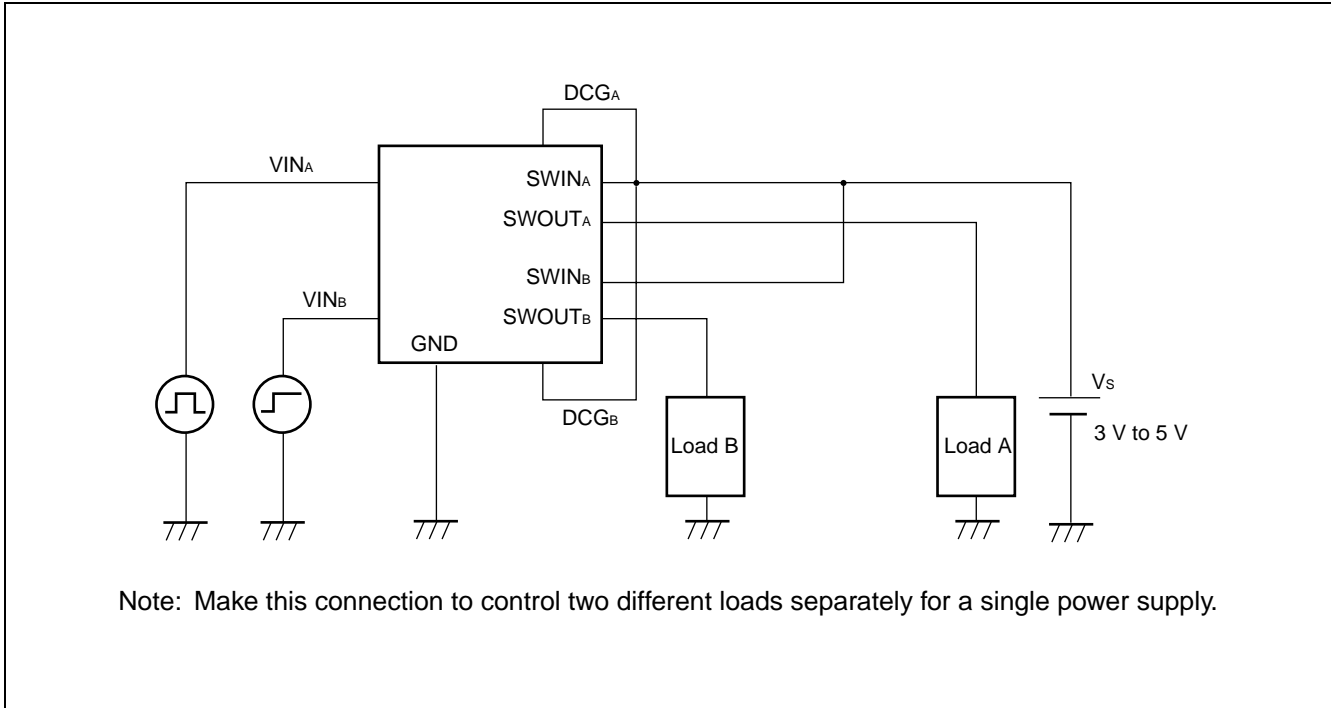
### 1. Separate Use of Two Switching Circuits



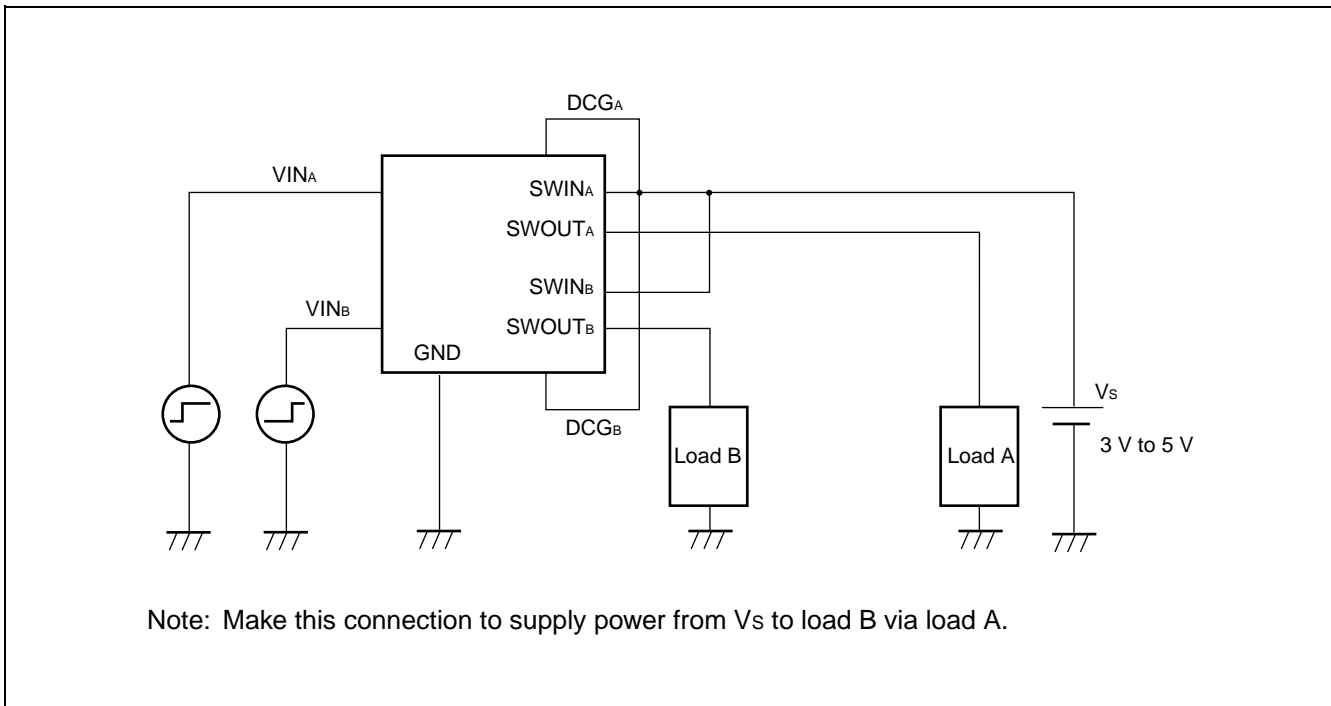
### 2. Switching Two Power Supplies



## 3. Switching Two Loads

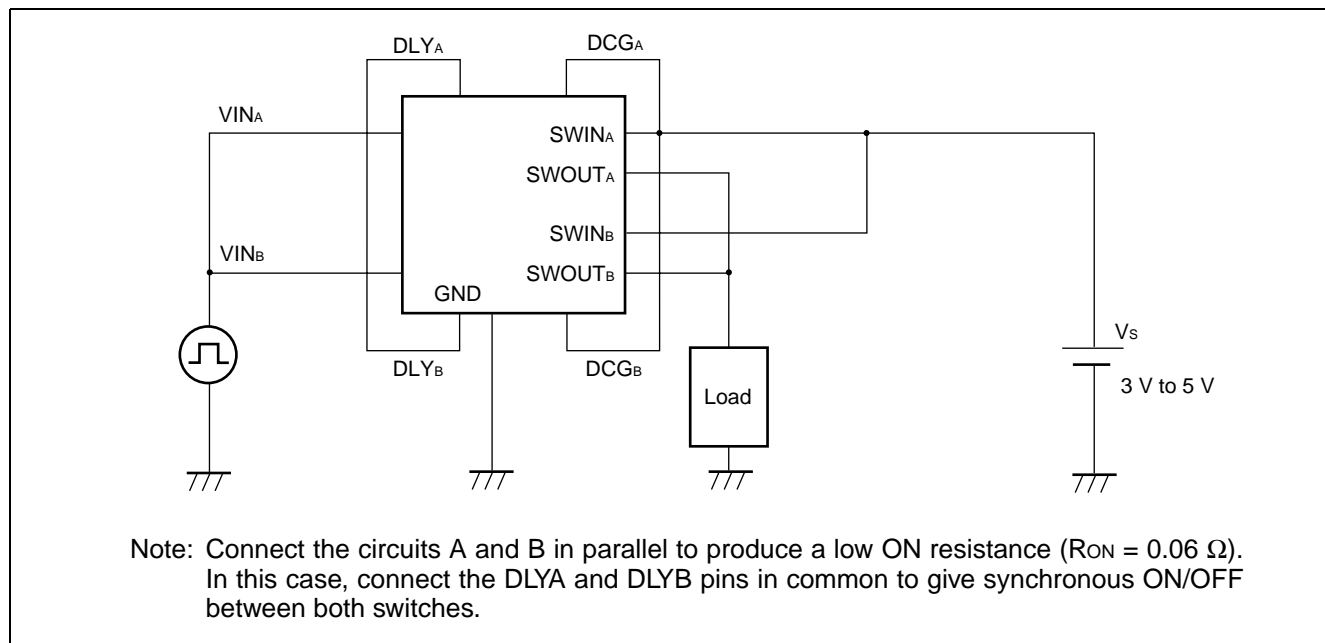


## 4. Connecting Serial Switches

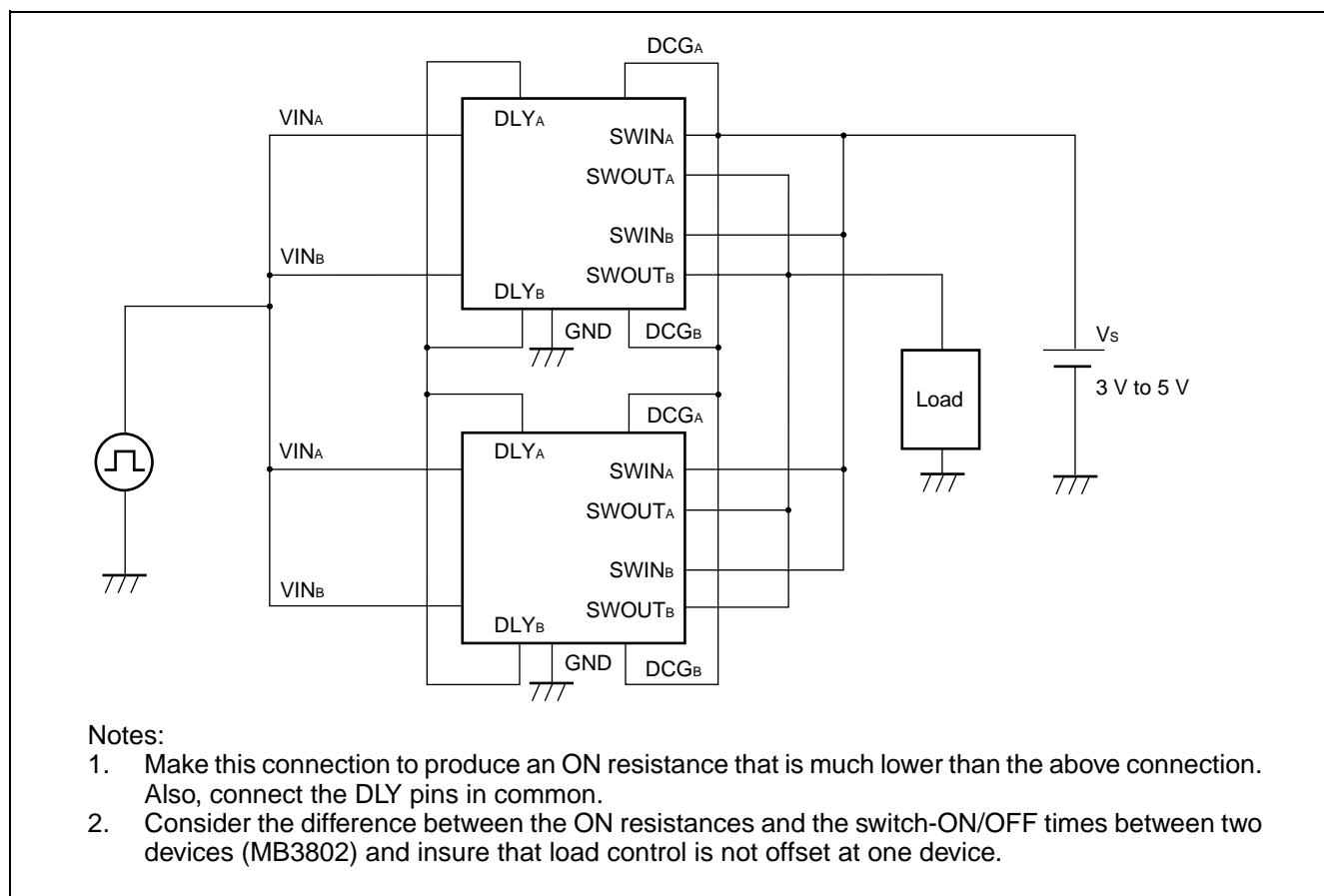




## 5. Connecting Parallel Switches

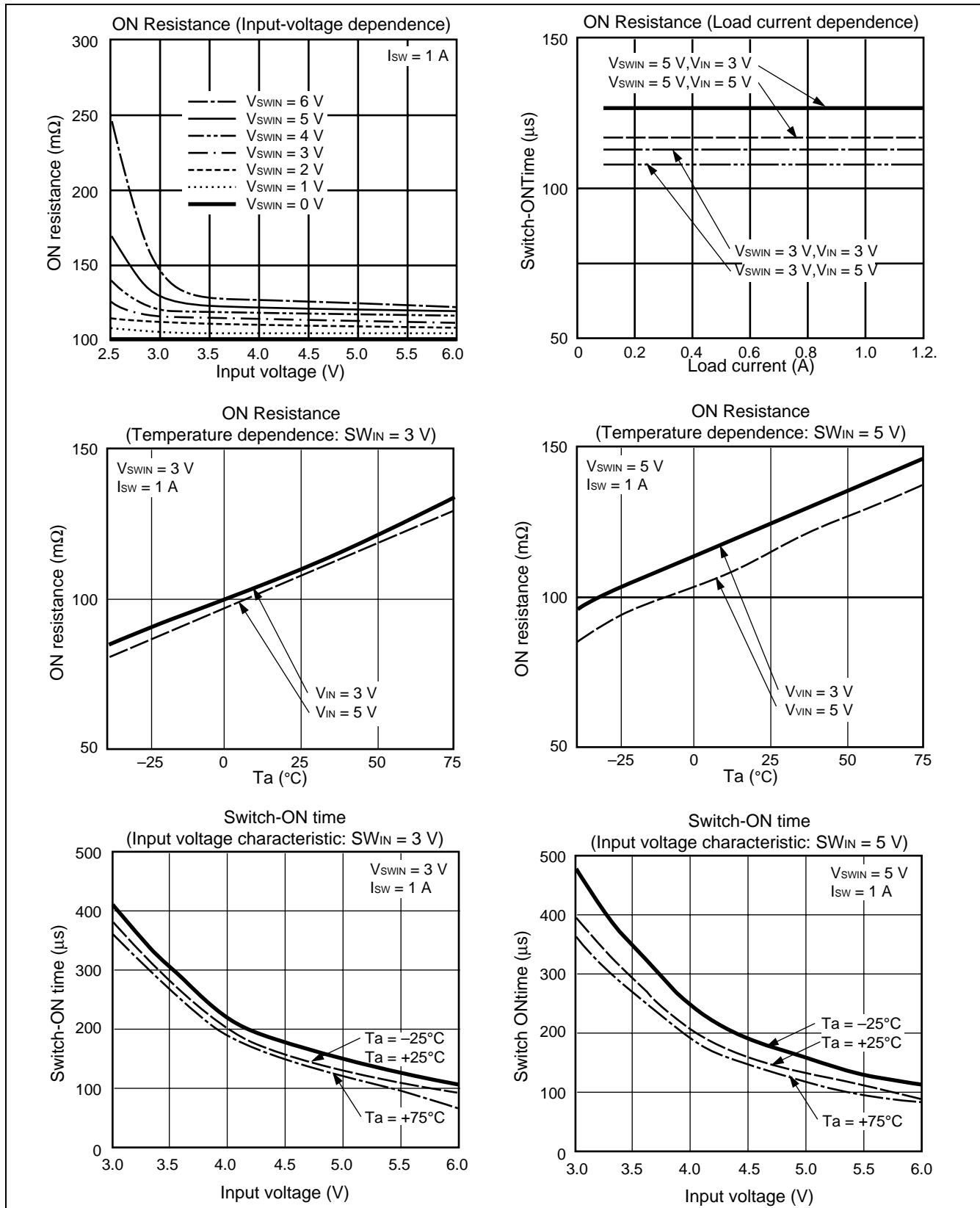


## 6. 25% ON Resistance

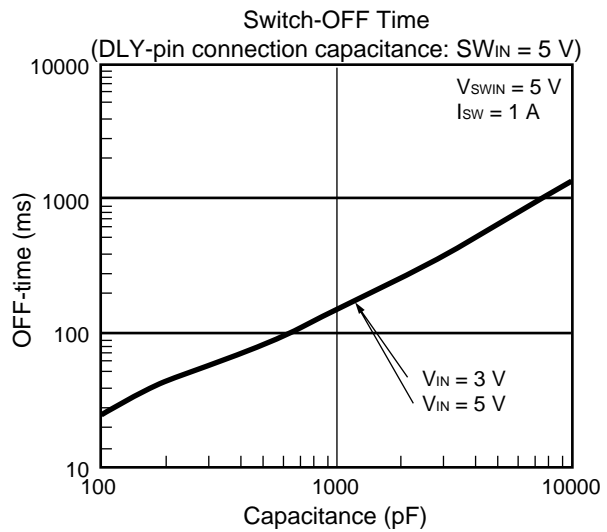
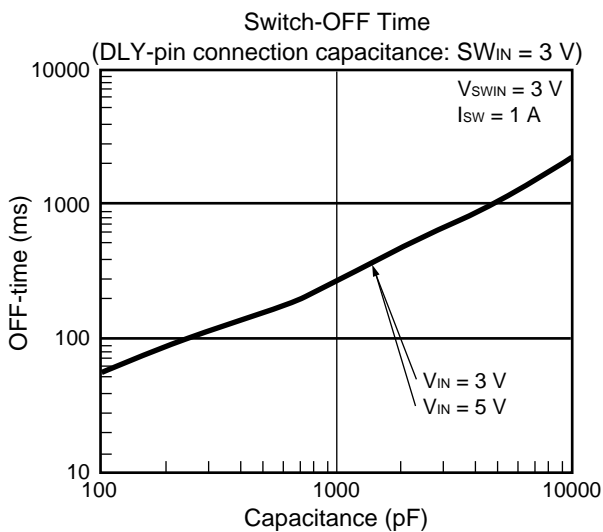
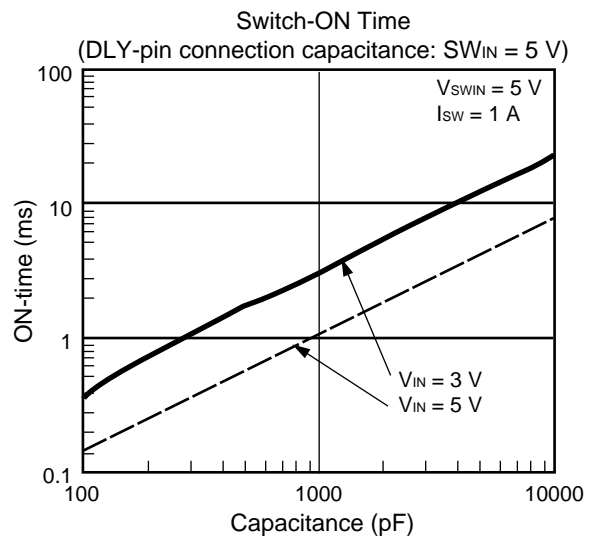
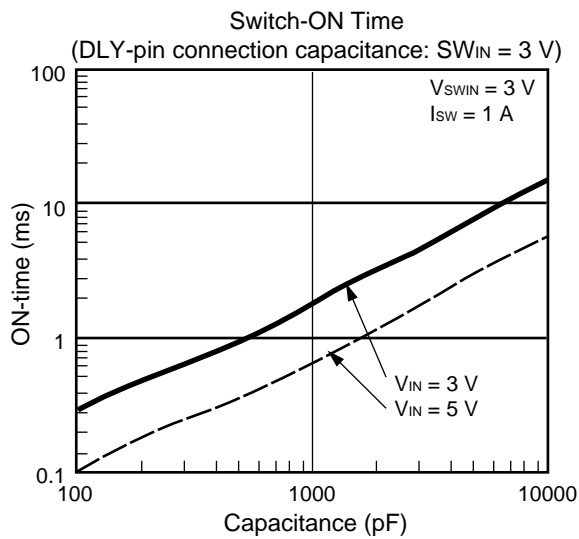
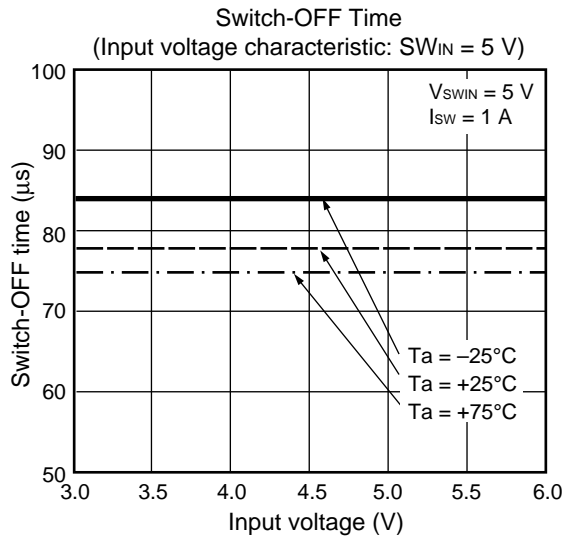
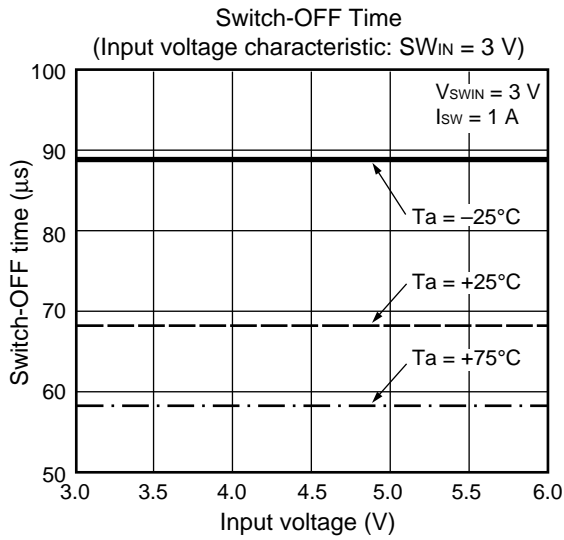




## ■ TYPICAL PERFORMANCE CHARACTERISTICS

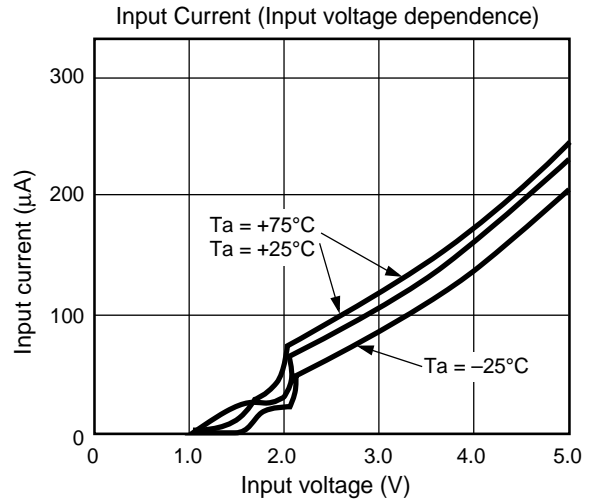
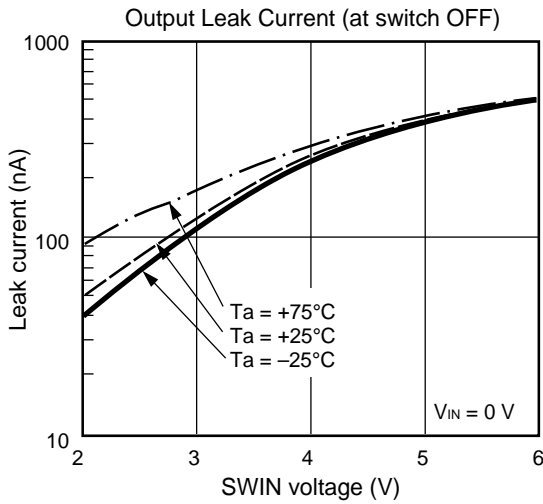
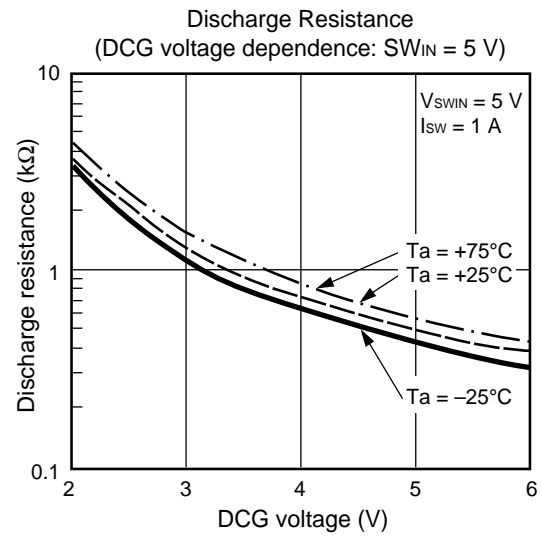
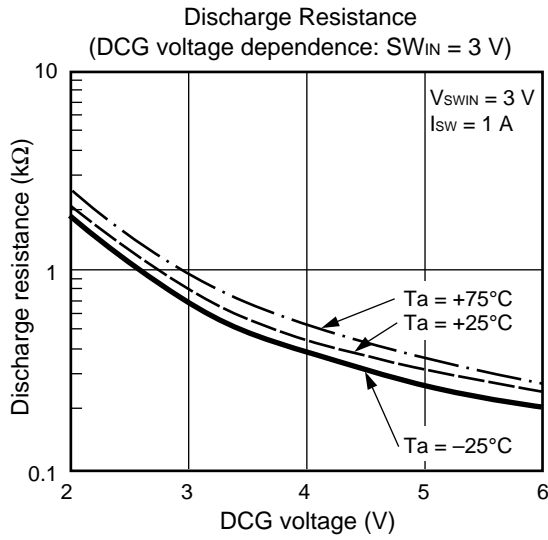


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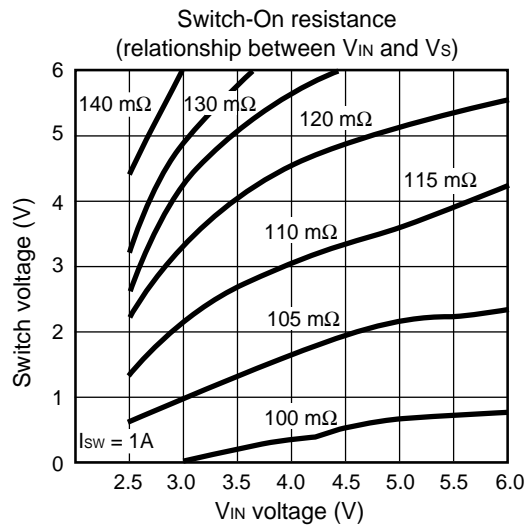
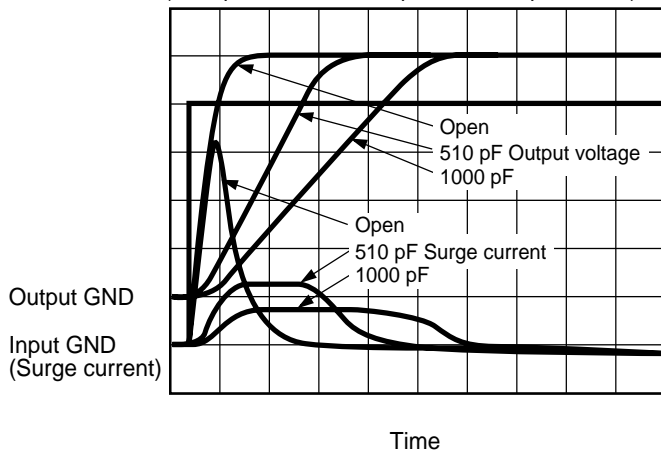


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**Surge Current and Output Voltage Boot**  
(DLY-pin connection capacitance dependence)



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

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

Load capacitance = 47  $\mu\text{F}$

V: 200 mA/div. (surge current)

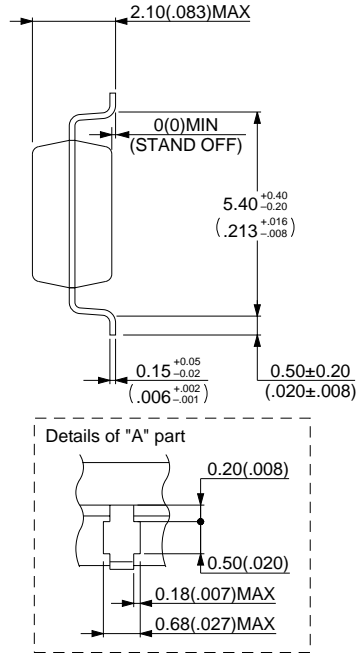
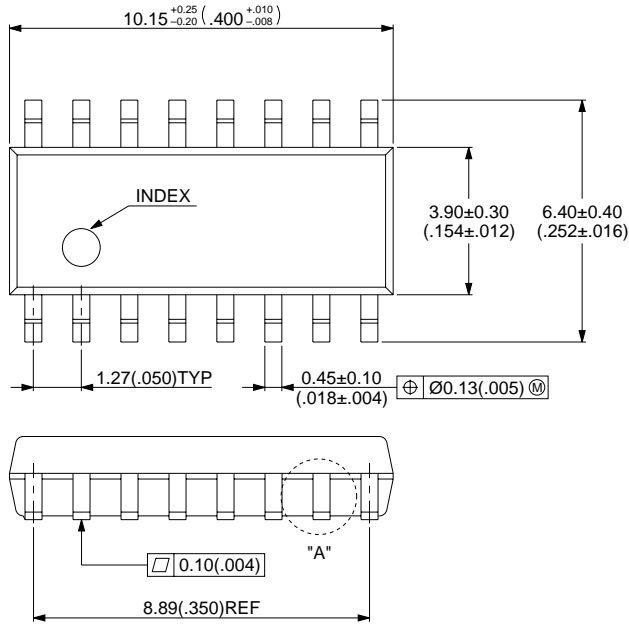
V: 1.0 V/div. (output voltage)

H: 200  $\mu\text{s}$ /div. (time axis)

# MB3802

## ■ PACKAGE DIMENSIONS

16-pin plastic FTP  
(FTP-16P-M04)



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Dimensions in mm (inch)

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