

MB3802

POWER MANAGEMENT SWITCH

DESCRIPTION

The MB3802 is a dual power management switch incorporating two identical switch circuits which have extremely low ON resistance and consume zero input current when the switches are turned OFF. These features effectively reduce power consumption and extend the battery life of portable, battery-driven products. The MB3802 can be used to efficiently control various power supply systems for Notebook Computers and typical peripheral devices such as Disk Drives and PCMCIA Cards.

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

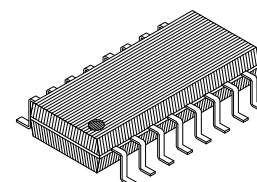
No external diode is required because the switch block is configured with an N-ch MOS structure to prevent the flow of reverse current at Switch-OFF.

Additionally, a load-side capacitor can be discharged at Switch-OFF by an internal discharge switch which is operated by an external control pin.

FEATURES

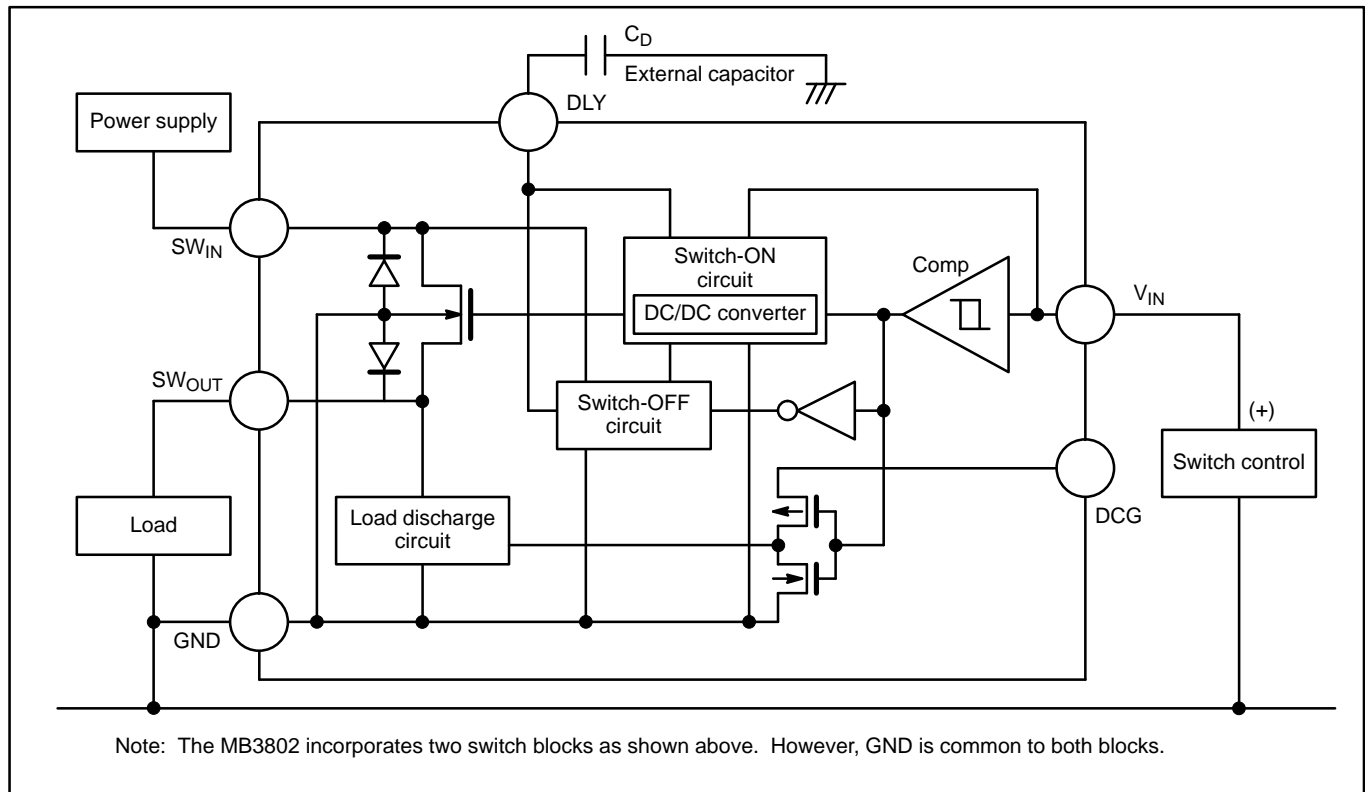
- Extremely low ON resistance:
 - $R_{ON} = 0.12 \Omega$ (typical)
 - $R_{ON} = 0.06 \Omega$ (typical for parallel connection)
- Reverse current protection at load side at Switch-OFF
- Operation start at low input voltage: $V_{IN} > 2.2$ V (typical)
- Low power consumption
 - At Switch-OFF: $I_{IN} = 0 \mu A$, $V_{IN} = 0$ 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
- 16 Pin Plastic Flat Package (Suffix: -PF)

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

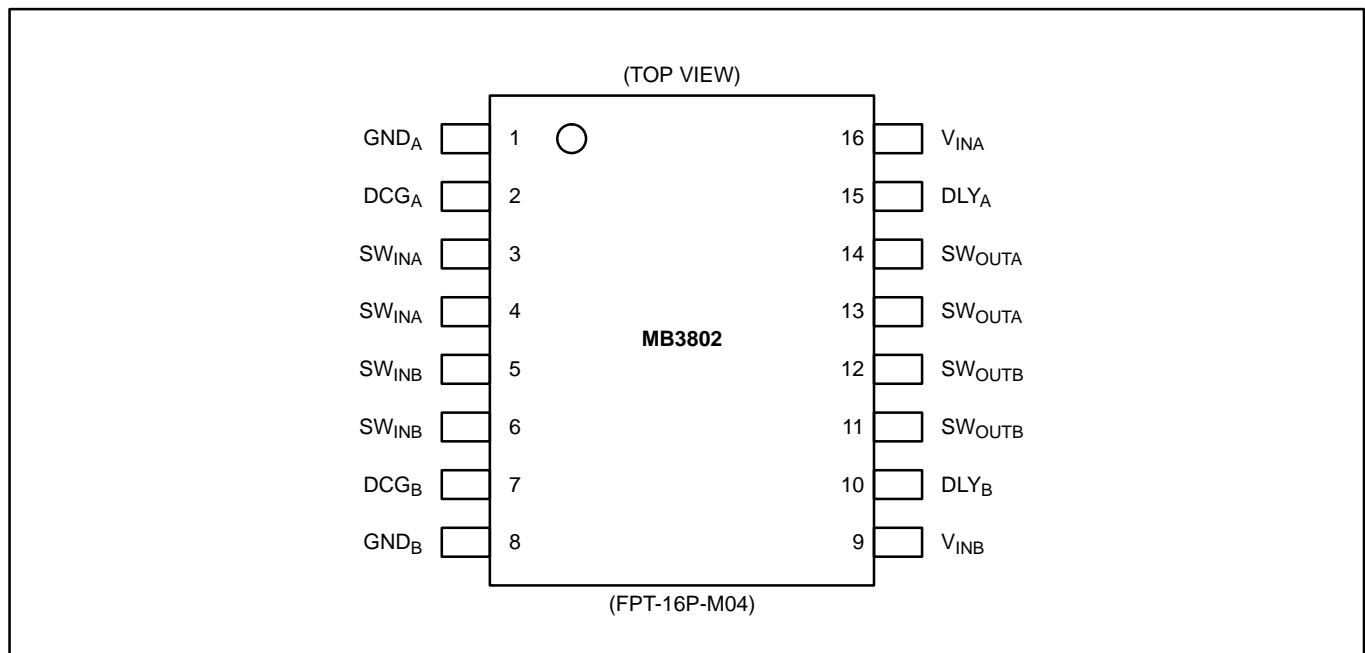


This device contains circuitry to protect the inputs against damage due to high static voltages or electric fields. However, it is advised that normal precautions be taken to avoid application of any voltage higher than maximum rated voltages to this high impedance circuit.

BLOCK DIAGRAM AND EXTERNAL CONNECTIONS



PIN ASSIGNMENT



BLOCK DESCRIPTION

When V_{IN} exceeds 2.2 V, the Comparator starts driving the DC/DC converter which boosts the V_{IN} voltage in order to switch the N-ch MOS, applying the optimum voltage to the switch gate.

When V_{IN} is below 2.1 V, the Comparator 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} .

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 reduced during power-on by controlling the Switch-ON time. The Switch-ON time is also dependent on the boot time of the DC/DC converter.

PIN DESCRIPTION

1. Power Management Switch

Pin No.	Pin Symbol	Description
16	V_{INA}	Switch Control Pins: These input control pins drive the Switch-ON with a High input level and Switch-OFF with a Low input level. They also serve as power-supply pins for the DC/DC converter to generate the switch gate voltage.
9	V_{INB}	
3, 4	SW_{INA}	Switch input pins: Two common pins are assigned to SW_{INA} and SW_{INB} . They serve as input power supply pins for the Load Switches and the Switch-OFF circuit.
5, 6	SW_{INB}	
13, 14	SW_{OUTA}	Switch output pins: Two common pins are assigned to SW_{OUTA} and SW_{OUTB} . They are typically connected to the high side of the controlled load. When DCGA or DCGB are at a High level, the respective load-discharge circuits implement the discharge function via these pins.
11, 12	SW_{OUTB}	
2	DCG _A	SW_{OUTA}/SW_{OUTB} discharge control pins: These pins are used to control the discharge of the load at Switch-OFF. Connect them to GND when the discharge function is not required.
7	DCG _B	
15	DLY _A	Switch-ON/OFF time 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 there is minimal current leakage (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	

ELECTRICAL CHARACTERISTICS

1. Absolute Maximum Ratings

(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
Total Power Dissipation	P _D	Ta ≤ +75 °C	290	mW
Storage temperature	T _{stg}	—	−55 to +125	°C

2. 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
DLY-pin connection capacitance	C _D	—	—	—	10	nF
DLY-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	—	+75	°C

3. DC Characteristics

(Ta = +25°C)

Parameter	Symbol	Conditions	Ratings			Unit
			Min.	Typical	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	V _{HYS}	—	50	100	—	mV
Switch resistance	R _{ON}	V _{IN} = 3 V, 5 V, I _{SW} = 0.5 A Ta = -40° to +75°C	—	—	210	mΩ
						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 current to switch discharge circuit	I _{DCG}	V _{DCG} = 5 V	—	0	2	μA

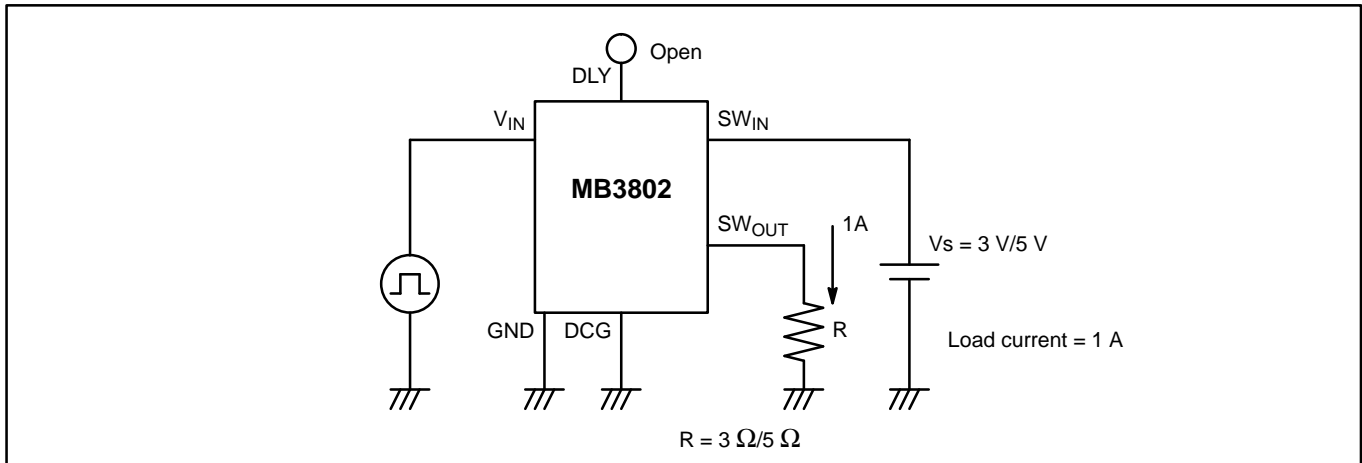
4. AC Characteristics

(Ta = +25°C)

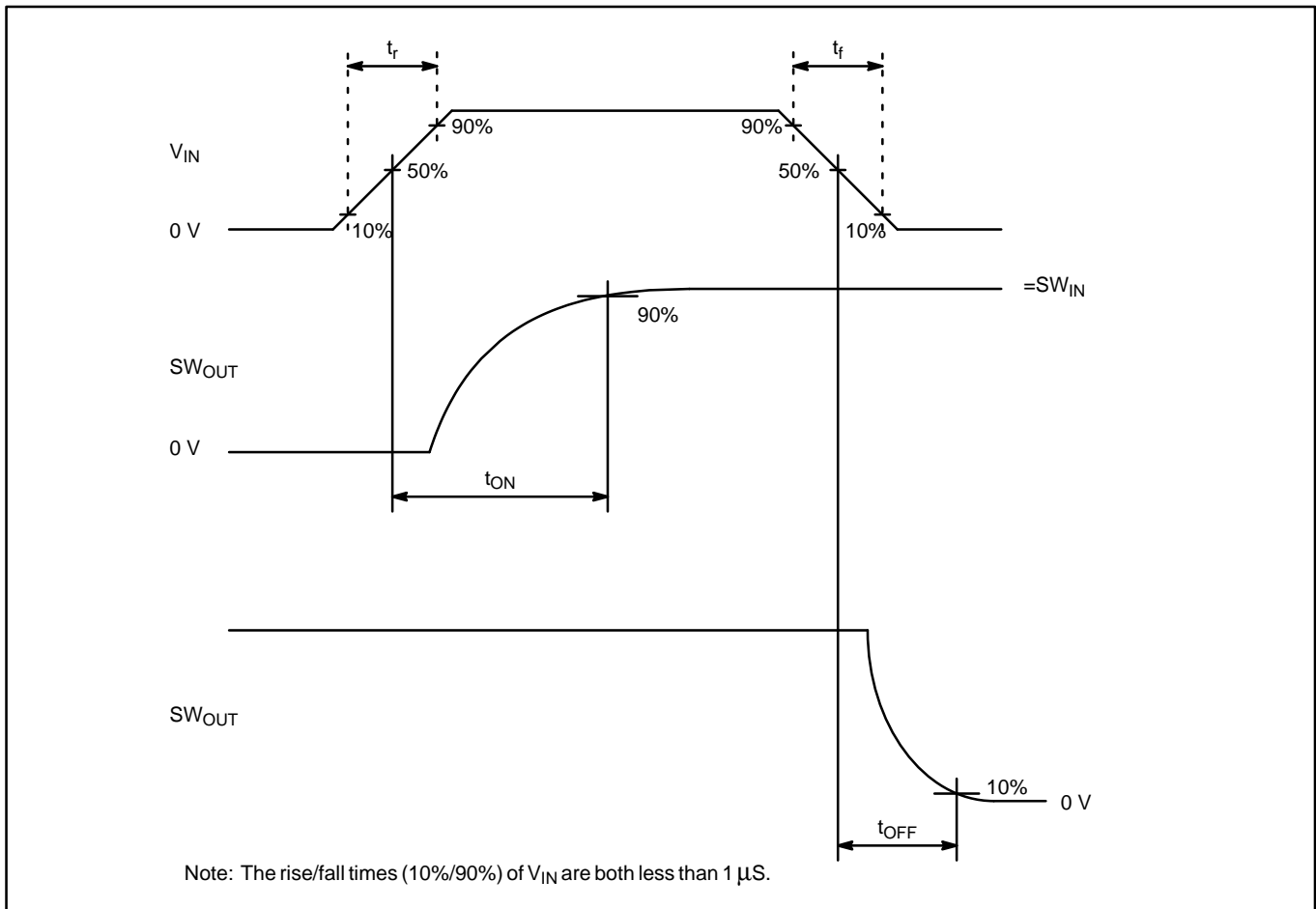
Parameter	Symbol	Conditions	Ratings			Unit
			Min.	Typical	Max.	
Switch-ON time	t _{ON1}	V _{IN} = 0 V → 3 V, V _{SWIN} = 3 V	100	300	900	μs
	t _{ON2}	V _{IN} = 0 V → 5 V, V _{SWIN} = 5 V	50	150	450	μs
Switch-OFF time	t _{OFF1}	V _{IN} = 3 V → 0 V, V _{SWIN} = 3 V	20	60	180	μs
	t _{OFF2}	V _{IN} = 5 V → 0 V, V _{SWIN} = 5 V	10	30	150	μs
Switch-ON/OFF time lag	t _{HYS1}	V _{IN} = 3 V/0 V, V _{SWIN} = 3 V	80	240	720	μs
	t _{HYS2}	V _{IN} = 5 V/0 V, V _{SWIN} = 5 V	40	120	300	μs

AC CHARACTERISTIC TEST DIAGRAMS

1. Test Condition

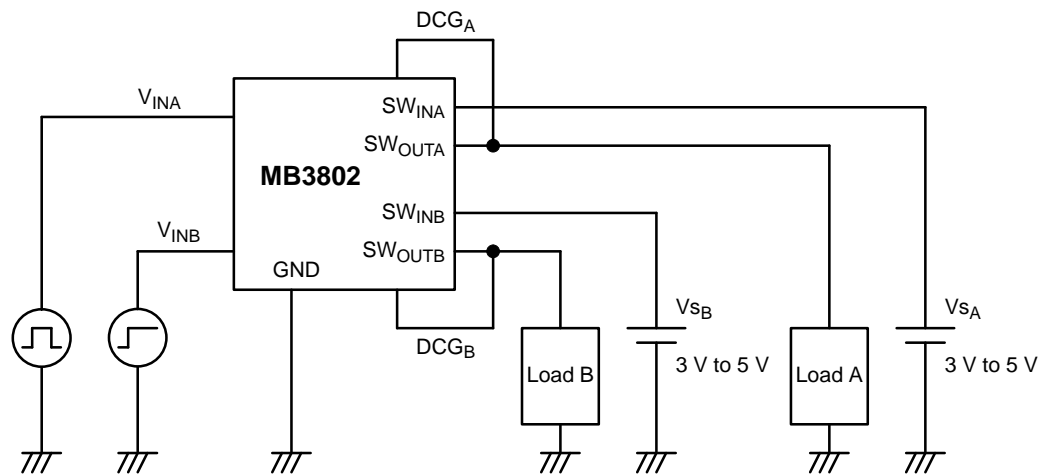


2. Switch-ON/OFF Timing Chart



APPLICATIONS

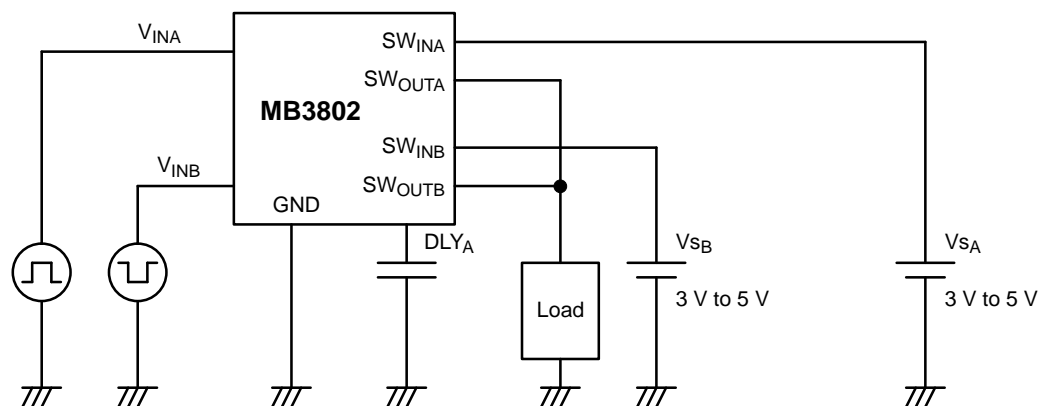
1. Separate Use of Two Switching Circuits



Notes:

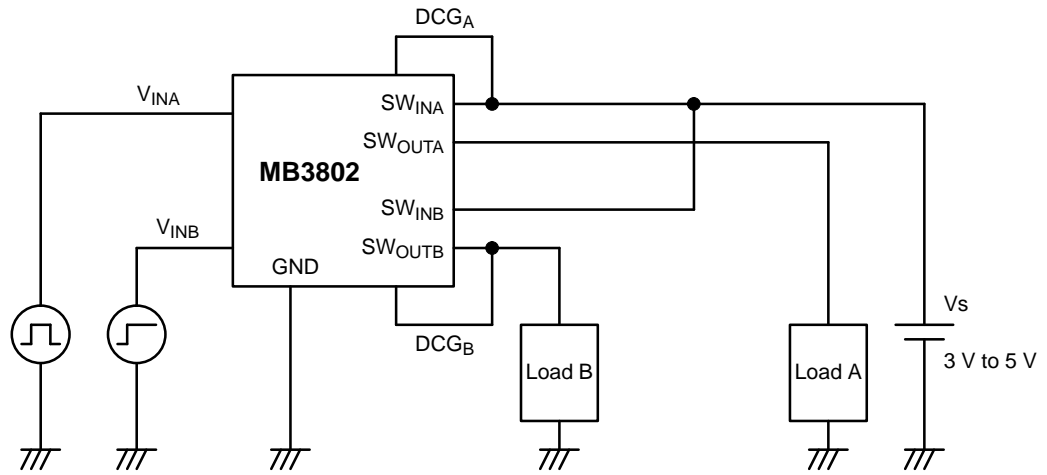
1. The two power supplies V_{SA} and V_{SB} can be used separately by controlling the voltages V_{INA} and V_{INB} .
2. Connect the DCG pin to GND when it is not used.

2. Switching Two Power Supplies



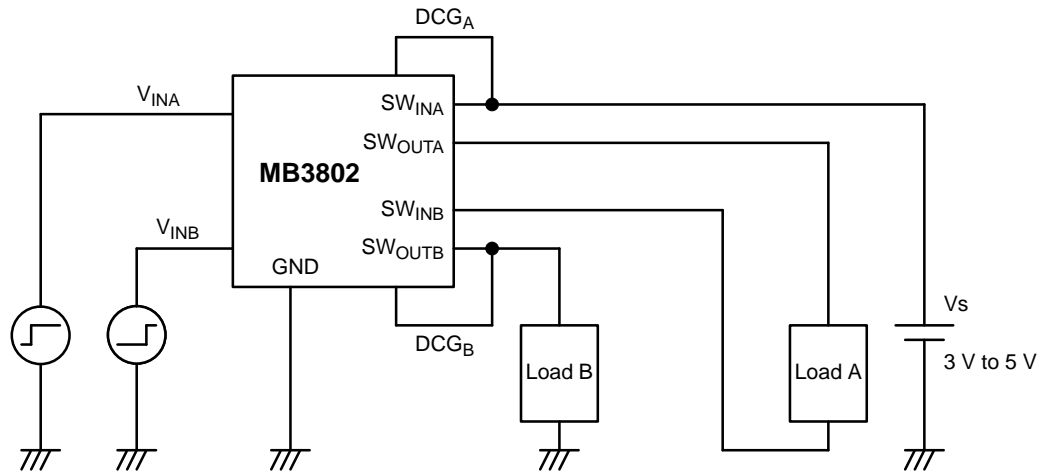
Note: When using different power supplies for a single load, control them by connecting an external capacitor so that both switches are not ON at the same time.

3. Switching Two Loads



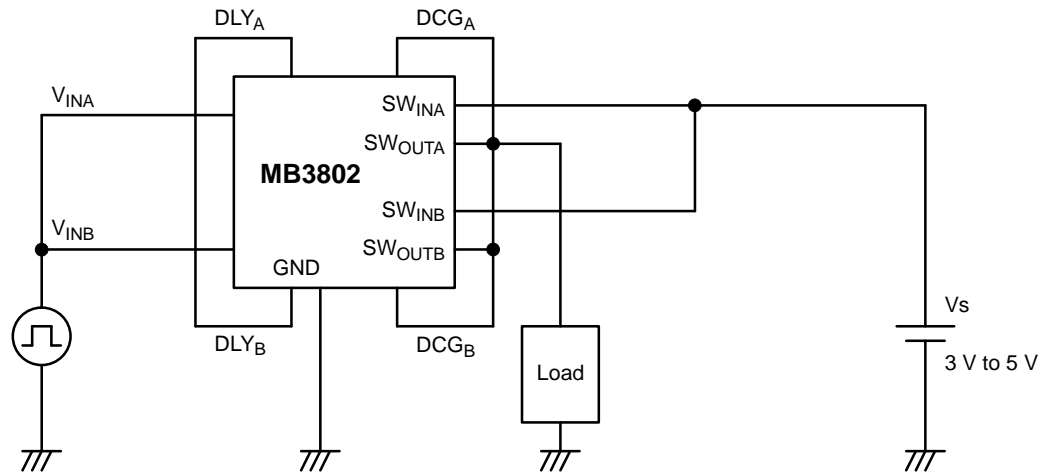
Note: Make this connection to control two different loads separately using a single power supply.

4. Connecting Serial Switches



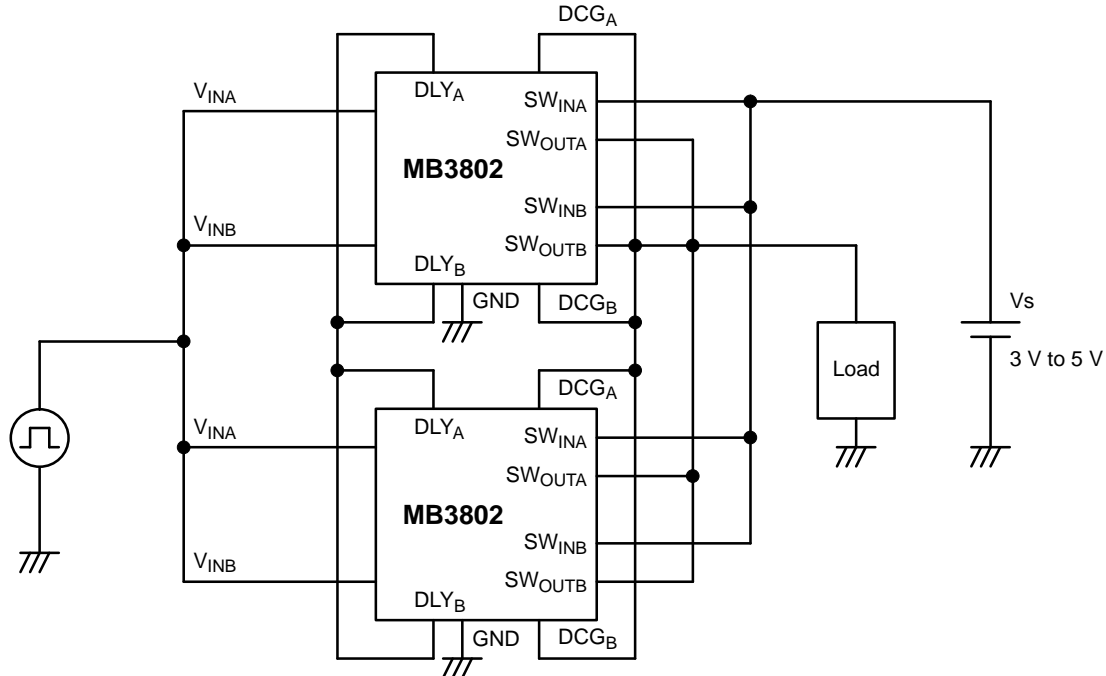
Note: Make this connection to supply power from V_S to load B via load A.

5. Connecting Parallel Switches



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

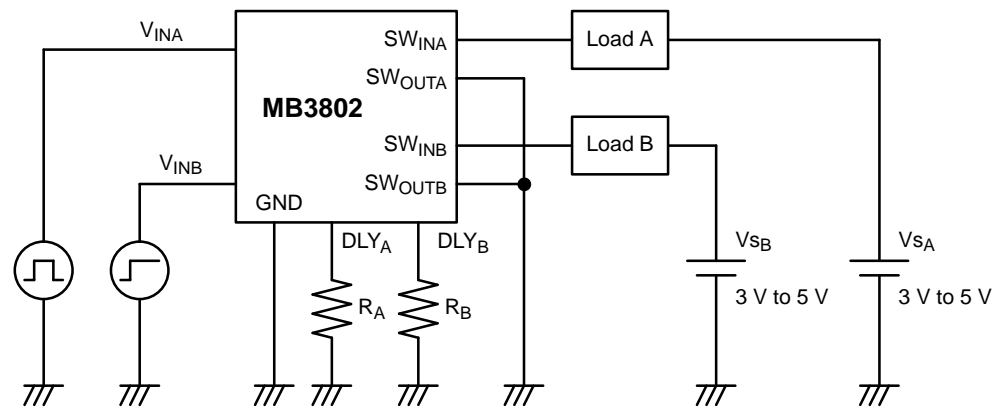
6. 25% ON Resistance



Notes:

1. Make this connection to produce an ON resistance that is much lower than the single device parallel switch connection (as shown in 5.) Also, connect the DLY pins in common.
2. Consider the differences between the ON resistances and the Switch-ON/OFF times between the two devices (MB3802) and insure that load control is not offset at one device.

7. Low-side Switch

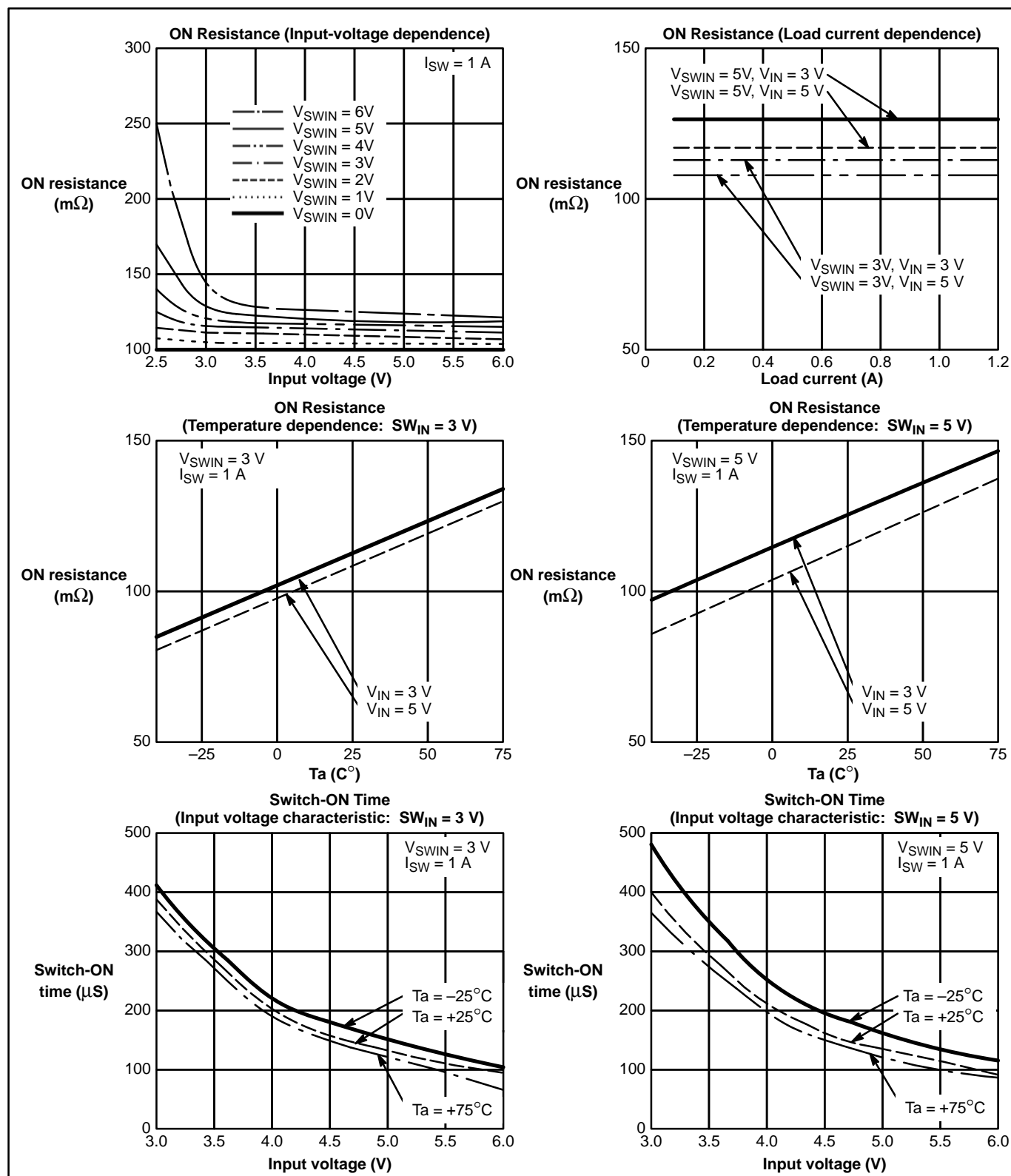


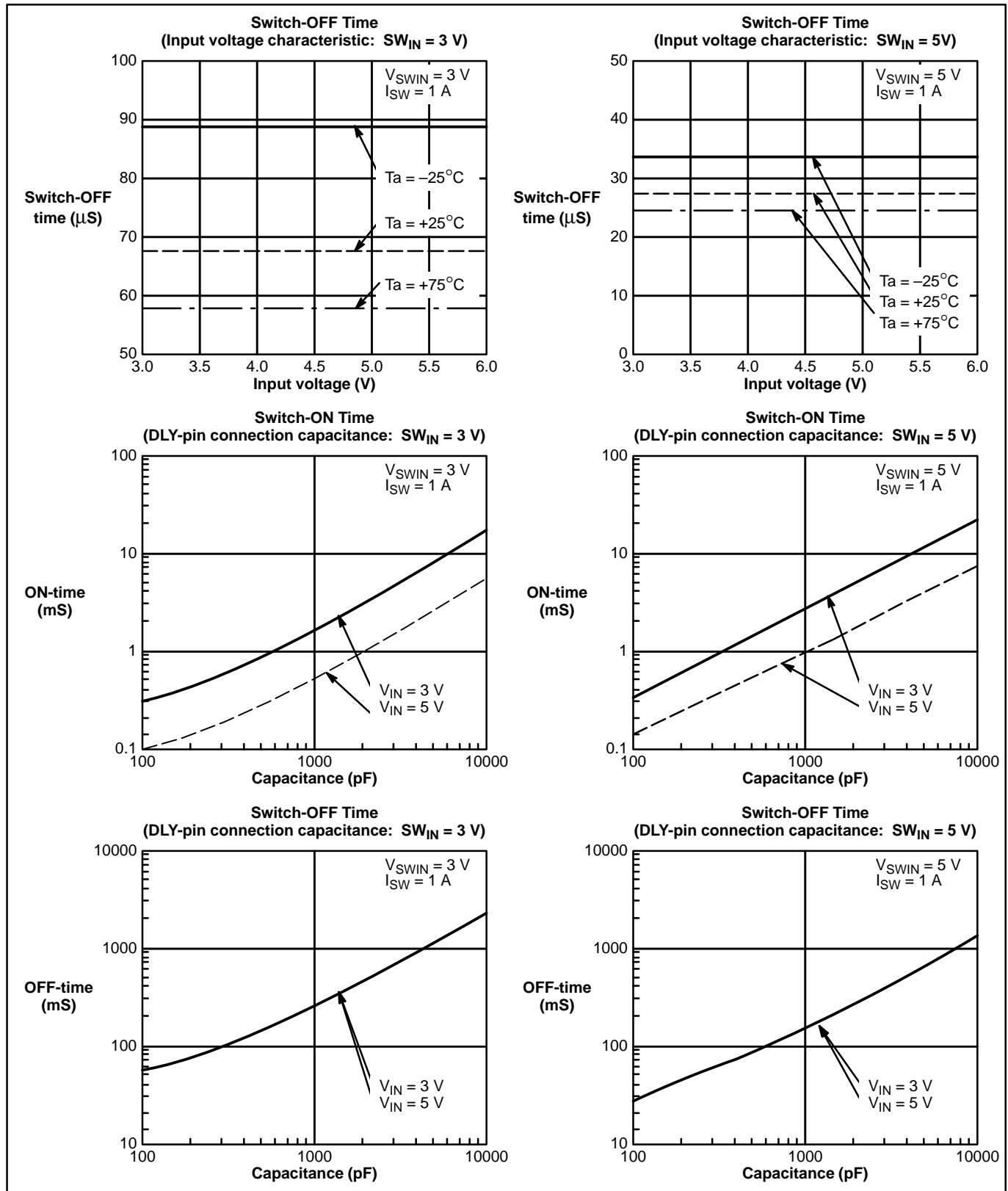
	$V_{IN} = 3\text{ V}, V_S = 3\text{ V}$	$V_{IN} = 5\text{ V}, V_S = 5\text{ V}$
Switch-ON time	80 μS	45 μS
Switch-OFF time	5.0 mS	3.5 mS

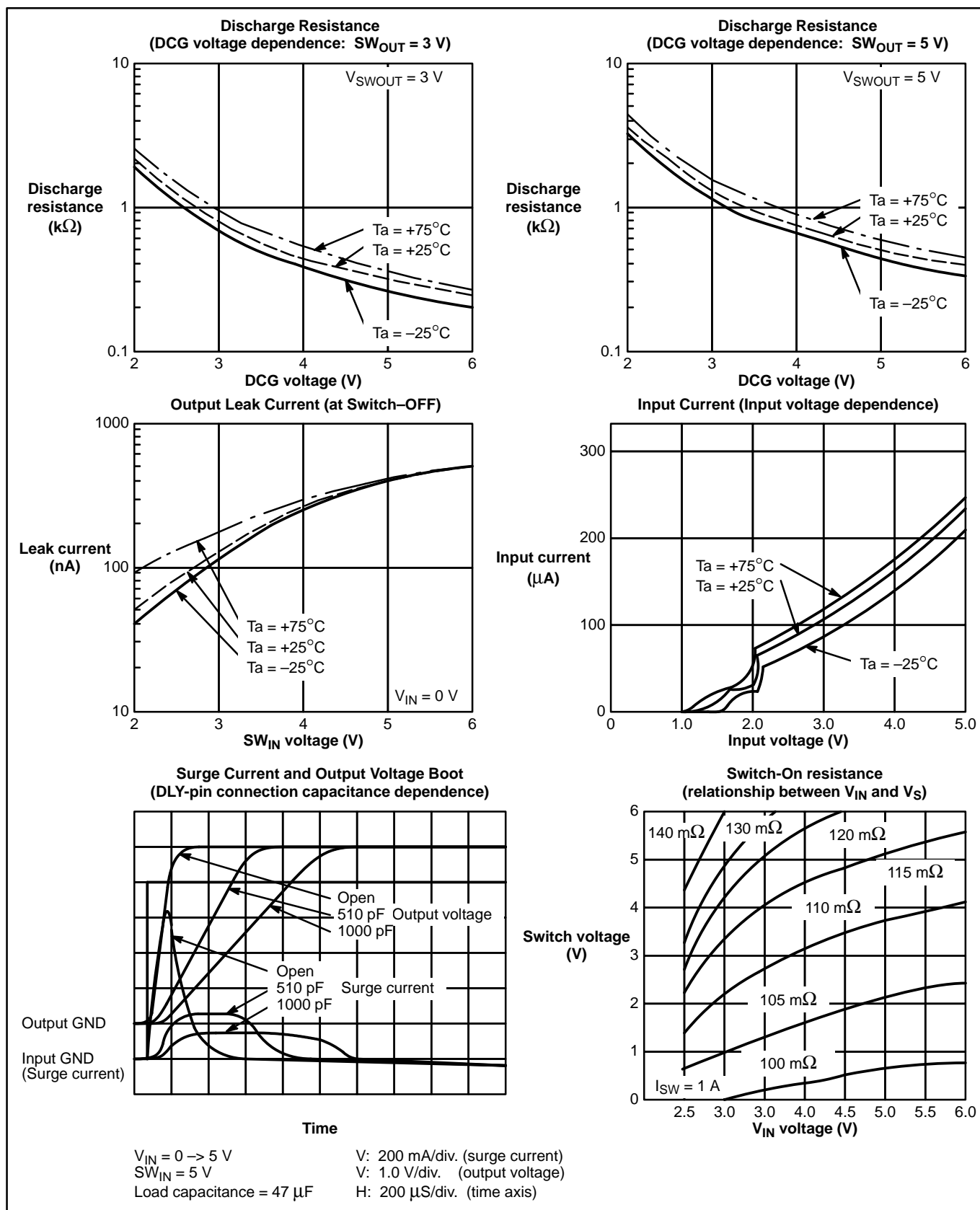
R_A and $R_B = 10\text{ M}\Omega$

- 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 $R_B = 5\text{ to }10\text{ M}\Omega$) to the DLY pins without overloading the DC/DC converter.
 - 3. With this connection, the Switch-OFF time is longer than the Switch-ON time.

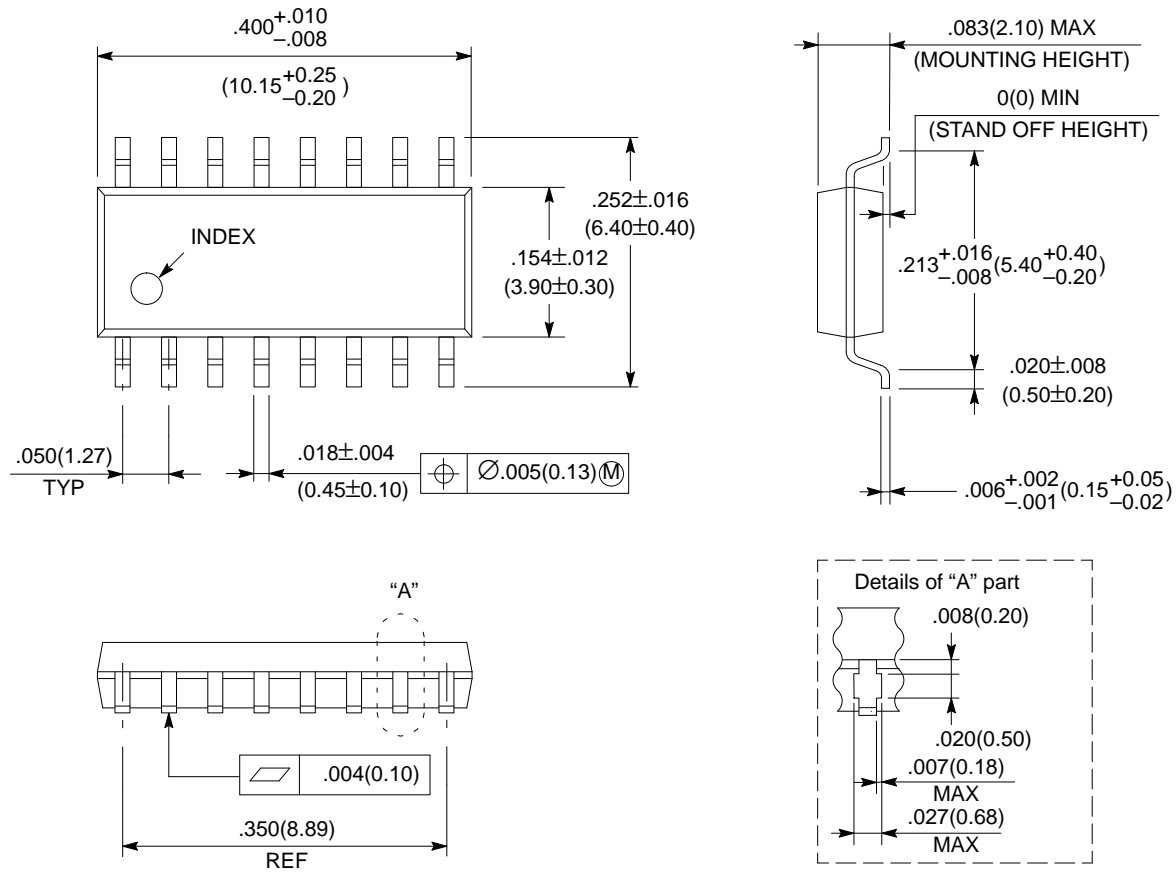
TYPICAL CHARACTERISTICS CURVES







**16-LEAD PLASTIC FLAT PACKAGE
(CASE No.: FPT-16P-M04)**



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Dimensions in
inches (millimeters)

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